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ABSTRACT

Annual use of fuel oil for heating schools and other facilities of the Montgomery County (Maryland) Public Schools, Montgomery County Government, and Montgomery College exceeds four-million gallons. This report examines the processes by which purchases and distributions of fuel oil are made, makes recommendations based on the examination, and suggests computer-assisted models to monitor and aid in decision-making about these processes. After an executive summary and introduction, chapter 1 describes the current fuel oil procurement and delivery systems and presents findings and conclusions about these processes. The second chapter (1) outlines two suggested computer-assisted financial analysis models, the procurement/delivery model, and the usage/price/expenditure model; (2) applies the models using computer simulation to evaluate cost differences for fiscal year 1984; (3) summarizes the study findings; and (4) offers recommendations. Included in five appendices are (1) the actual computer simulations; (2) a computer scenario of how the usage/price/expenditure model might be utilized; and (3) the computerized fuel oil cost evaluation analysis for fiscal year 1984. Sixteen exhibits are included in the report. (WTH)

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MONTGOMERY COUNTY
PUBLIC SCHOOLS
ROCKVILLE, MARYLAND

Report on the Procurement and Delivery of Fuel Oil

May 1985

EA 019 362

Wilmer S. Cody
Superintendent of Schools

Prepared by the Department of Educational Accountability

REPORT ON THE PROCUREMENT AND DELIVERY OF FUEL OIL

by

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May 1985

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EXECUTIVE SUMMARY

PROCUREMENT AND DELIVERY OF FUEL OIL

Introduction

The Montgomery County Public Schools (MCPS), along with the Montgomery County Government and Montgomery College for which MCPS is the procurement agent, is currently using more than four-million gallons of fuel oil annually for heating schools and other facilities. At this level of consumption, even tiny variations in the cost-per-gallon multiply into thousands of dollars of savings or added costs. Effective and efficient management of the procurement, delivery, and consumption of fuel oil is essential.

This report examines the processes by which MCPS purchases and distributes fuel oil for heating, makes recommendations based on the examination, and suggests computer-assisted models which managers can use periodically to monitor and make decisions about these processes.

Current Process and Procedures

Prior to FY 1984, fuel oil purchases were accomplished through MCPS' own annual process of bidding and contract award. The Division of Procurement, with the assistance of the Divisions of Supply and Property Management and Construction and Capital Projects, prepared specifications, issued invitations to bid, conducted the formal bid reviews, and awarded the contracts. In FY 1984, MCPS began purchasing fuel oil through a cooperative contract awarded by the Washington Metropolitan Council of Governments (COG). The contract awarded for MCPS is different from the contracts of other COG members in that MCPS is the only member that hauls its own fuel oil from vendor distribution points.

The same MCPS organizational units have been involved in the fuel oil procurement and distribution processes under both the COG and individual MCPS contracts. The most important of these units are the following:

- Division of Supply and Property Management, which is responsible for receiving fuel oil orders from the schools and other sites and, in response, ensuring timely and efficient delivery
- Division of Procurement, which is responsible for preparing fuel oil contract requirements, negotiating with the other COG members, and monitoring price changes provided for in the contract
- Division of Construction and Capital Projects, which is responsible through its Energy Management Unit for monitoring fuel oil prices, suggesting modifications in the delivery schedule to take advantage of price fluctuations, and maintaining various fuel oil records necessary for management decision making

- MCPS Sites (schools and other buildings), which are responsible for measuring the fuel oil on hand and placing requests for deliveries

- Division of Accounting, which is responsible for compiling and reconciling fuel oil delivery tickets with vendor invoices and issuing payments

The current procedures for ordering and delivering fuel oil are generally well managed. However, the following four aspects of the procedures require discussion:

- Written guidelines to instruct school-based personnel when to order a fuel oil delivery do not exist. Although managers report that unwritten guidelines are included in the school plant operators' training course, study data show that actual practice varies from the guidelines, which are either not remembered or not enforced. One corrective action which could be taken immediately is to publish and enforce written guidelines, based on tank capacities, for school-level personnel to follow. On a longer-term basis, an automatic delivery system, based on degree days and other factors, would relieve school-based personnel from the ordering responsibility.

- Currently, internal controls to verify fuel oil delivery at school sites and the amount of oil delivered are inadequate. Fuel tankers have no meters, and tanker drivers return the tickets directly to the Division of Supply and Property Management. An immediate improvement would be for the school building services manager or plant operator to be required to measure the tank before and after each delivery, estimate the amount of fuel oil delivered, sign, and return the fuel oil ticket to the Division of Supply and Property Management. A more satisfactory solution would be to install automatic metering devices on each tanker to record the fuel oil delivered.

- A 1982 management study questioned, but left unanswered, the need for continuing the current practice of topping off fuel oil tanks each spring in order to prevent condensation. The study noted that $35,000 of additional revenue from interest would have been generated by delaying the fuel oil purchases until the fall. However, data collected for this report justifies the topping-off process as being cost-effective unless there is strong reason to believe that fuel prices will drop sharply between spring and fall.

- Major responsibility for managing fuel oil procurement, delivery, and usage is divided among three separate MCPS units. However, the administrative procedures for monitoring this $4 million annual expenditure are largely informal, unwritten, and sometimes overlapping. MCPS should formalize in writing the necessary administrative procedures.

Computer-Assisted Models for Monitoring Fuel Oil Purchasing, Delivery, Usage, and Expenditures

Although, with the exceptions noted, current processes for the procurement and delivery of fuel oil are generally well managed, they do not take advantage of some of the available, relatively inexpensive technology for monitoring and analysis. Therefore, study staff designed two computer models as examples of the type of support which could be made available.

One model provides a framework for decision making in considering the alternatives for the procurement and delivery of fuel oil. The primary alternative tested was MCPS delivery compared to vendor delivery. The second model monitors current usage, price, and expenditures for fuel oil and projects future expenditures based on various "What if?" conditions. Test runs of these models, using FY 1984 data, suggest some overall recommendations for the fuel oil procurement and delivery process.

According to the FY 1984 data used in the study simulations, the cost of the fuel oil program with MCPS delivery was approximately $3,274,000; and the cost of the program if the vendor had delivered would have been approximately $3,260,000. The difference of $14,000 represents a modest savings theoretically available to MCPS had it used vendor delivery. In addition, under the vendor delivery alternative, Montgomery County Government would have collected $54,600 in FY 1984 from the fuel oil tax, which is only assessed on vendor delivered oil.

Other simulation runs, also using FY 1984 base data, but applying various "What if?" conditions, revealed the following:

- If MCPS usage had increased and fuel prices had remained the same, the direct savings to MCPS from vendor delivery would have decreased, with the break-even point occurring at a 20 percent usage increase.

- If MCPS usage had decreased and fuel prices had remained the same, the direct savings to MCPS from vendor delivery would have increased, reaching $25,600 at a 20 percent decrease.

- If fuel prices had changed, either increased or decreased, there would have been no effect on the cost differences between the MCPS and vendor delivery alternatives.

Running these various simulations shows that, based on FY 1984 data, it would be financially advantageous under nearly all circumstances for MCPS to cease hauling its own fuel oil. However, two sets of factors must be examined before reaching any conclusion.

First, MCPS managers raised a series of questions regarding (a) who, the vendor or MCPS, has the responsibility for assuring uninterrupted deliveries; (b) whether a vendor or MCPS has the opportunity to alter the timing of deliveries for financial advantage; (c) whether vendor delivery provides as good a control over needed financial information as does MCPS delivery; and (d) whether the amount of paperwork is significantly greater under either alternative.

Study investigations showed that a solution is available for addressing the issue of the timely collection of financial information and that the other three issues do not necessarily discriminate between MCPS and vendor hauling programs and cannot be considered a certain advantage or disadvantage for either alternative.

Second, an uncertainty was raised by the break-even point for direct savings to MCPS, which is projected to occur if there is a 20 percent increase in the use of fuel oil for any reason. Beginning in FY 1985, MCPS started hauling fuel oil to 30 of the 39 schools previously served by the vendor. If this increase were combined with increased fuel oil for new schools or to meet a colder winter than FY 1984, total MCPS fuel oil usage could easily be 20 percent greater.

On the other hand, increasing MCPS salary costs and the possible need for either additional driver overtime or a fourth driver and tanker to deliver the increased amount of fuel oil might bring the vendor delivery alternative back into the cost-effective range even with more than 20 percent usage increase.

To examine the combined effects of possible future events, additional simulations were run, using the FY 1984 baseline data, but adding various other assumptions regarding future increased costs and increased usage. The results of these simulations show that, if MCPS delivery costs increase at the same time as usage increases, vendor delivery is the more cost-effective alternative. But, if usage increases without a significant corresponding increase in delivery costs, continued MCPS delivery of its own fuel oil would be more cost effective.

Recommendations

Primary Recommendations

The findings of this study suggest the following primary recommendations regarding the procurement and delivery of fuel oil:

- MCPS managers responsible for fuel oil procurement and delivery should develop long-range projections, in as much detail as possible, for continuing MCPS fuel oil usage (based on the Capital Improvements Program, when adopted, and other identifiable factors) and for MCPS delivery costs in relation to the projected usage. The study simulation model and/or any other available supports might be used for assisting with these projections.

- If the projections indicate that future usage will be at least 20 percent greater than for FY 1984 and that MCPS delivery costs to handle the total projected usage will not increase substantially, the alternative of MCPS delivery should be continued.

- If, on the other hand, the projections show corresponding increases in both usage and MCPS delivery costs, conversion to the alternative of vendor delivery should be implemented.

Other Recommendations

In addition to the primary recommendations regarding fuel oil delivery, the following recommendations for improving the current procedures for the procurement and delivery of fuel oil in MCPS should also be implemented:

1. The simulation models described in this report (or any other monitoring and projection techniques which can accomplish the same types of objectives--e.g., possibly the Department of Energy X11 model cited by managers when they reviewed this report) should be used by the Energy Management Unit to monitor and project fuel oil usage, price, and dollar expenditures.

2. To facilitate monitoring fuel oil usage, MCPS should establish procedures to collect copies of the fuel oil delivery tickets directly from schools on a daily basis and other fuel oil delivery data by COG price periods.

3. Management procedures for administering the fuel oil procurement, delivery, and usage processes should be clarified, formalized, and issued in writing.

4. The topping-off process should continue as in the past unless the unit responsible for monitoring the price of fuel oil predicts a substantial price decrease between the spring and fall periods.

If the steps listed as "Primary Recommendations" lead to MCPS' continuing its own fuel oil hauling program, the following additional recommendations should be implemented:

1. MCPS should develop and issue to all building services managers and school plant equipment operators written guidelines for determining when to order fuel oil deliveries. These guidelines should be based on tank capacities rather than on school types.

2. On a longer-term basis, MCPS should evaluate an automatic delivery and fill system which would substantially eliminate school-based responsibility for ordering fuel oil.

3. Fuel oil delivery procedures should be modified to require a school-based staff member to verify fuel oil deliveries and estimate the amount delivered. The record of the delivery and amount should be returned directly to the Division of Supply and Property Management, not through the truck driver.

4. As a more adequate control and data device, MCPS should install flow meters on the delivery tankers.

TABLE OF CONTENTS

Page

INTRODUCTION..... 1

CHAPTER 1: CURRENT PROCESS AND PROCEDURES

Process Description..... 3

Division of Supply and Property Management..... 4
Division of Procurement..... 6
Individual Schools and Other Buildings..... 6
Division of Construction and Capital Projects..... 7
Division of Accounting..... 7

Findings and Conclusions..... 8

Ordering Fuel Oil at Individual Schools..... 8
Receiving Fuel Oil at Individual Schools..... 9
Topping Off.....10
Overall Procedures and Processes.....10

CHAPTER 2: COMPUTER-ASSISTED MODELS FOR MONITORING FUEL OIL PURCHASING, DELIVERY, USAGE, AND EXPENDITURES

Introduction.....13
The Procurement/Delivery Model.....13

Possible Alternatives for Purchase and Delivery.....14
Major Cost Components.....14
Assumptions Underlying Assessment of Alternatives.....14
Layout of the Model.....15

The Usage/Price/Expenditure Model.....15

Elements of the Model.....16
Assumptions Underlying the Model.....16
Layout of the Model.....16

Application of the Procurement/Delivery Model.....17

Findings 17

Responsibility for Uninterrupted Deliveries.....20
Timing Deliveries for Financial Advantage.....20
Control of Financial Information.....21
Paperwork.....23

Discussion and Recommendations.....23

Fuel Oil Delivery.....23
Primary Recommendations.....26
Other Recommendations.....27

APPENDICES

APPENDIX A	Government Agencies Participating in the Washington Area Council of Governments (COG) Fuel Oil Procurement
APPENDIX B	The Work Processes and Relationships Involved in MCPS Fuel Oil Purchase and Distribution
APPENDIX C	The Procurement/Distribution Simulation Model
APPENDIX D	A Model for Monitoring Current Fiscal Year Usage, Price, and Expenditures for Fuel Oil
APPENDIX E	Application of the Procurement/Delivery Model to FY 1984

PROCUREMENT AND DELIVERY OF FUEL OIL

INTRODUCTION

The Montgomery County Public Schools (MCPS), along with the Montgomery County Government and Montgomery College for which MCPS is the procurement agent, is currently using more than four-million gallons of fuel oil annually for heating schools and other facilities. At this level of consumption, even tiny variations in the cost-per-gallon multiply into thousands of dollars of savings or added costs. Effective and efficient management of the procurement, delivery, and consumption of fuel oil is essential.

This report examines the processes by which MCPS purchases and distributes fuel oil for heating, makes recommendations based on the examination, and suggests computer-assisted models which managers can use periodically to monitor and make decisions about these processes.

Although conservation of energy is an important issue in the management and use of fuel oil, this study does not address that issue. MCPS has devoted a great deal of attention to conservation over the past decade, and significant savings have been realized.

The report is divided into two chapters. Chapter 1 describes the current MCPS fuel oil procurement and delivery systems and presents findings about these processes. Chapter 2 outlines two suggested computer-assisted financial analysis models, applies the models using FY 1984 data, summarizes the study findings, and offers recommendations.

Data for the report were collected from records reviews, computer reports, interviews, observations, school personnel questionnaires, and visits to other school districts.

CHAPTER 1

CURRENT PROCESS AND PROCEDURES

Process Description

The dollar amounts for MCPS fuel oil purchases from FY 1969 to FY 1983 are shown in Exhibit 1. The figures include fuel oil purchased for and delivered to Montgomery County Government and Montgomery College. The increase in FY 1975 is primarily the result of the oil embargo. The dollar values through FY 1982 reflect the continued higher costs. The significant decrease in total fuel oil expenditures from FY 1982 to FY 1983 is due to four factors: (1) a warmer than normal winter, (2) the lower cost of fuel oil during the heating season, (3) the one-time closing of 18 schools, and (4) a speed up in the end-of-year process for topping off the fuel tanks.

Prior to FY 1984, fuel oil purchases were accomplished through MCPS' own annual process of bidding and contract award. The Division of Procurement, with the assistance of the Divisions of Supply and Property Management and

EXHIBIT 1

Fuel Oil Purchases FY 1969 - FY 1983*

Fiscal Year	Dollar Value
1969	$ 566,966
1970	652,777
1971	1,136,600
1972	1,045,548
1973	1,024,321
1974	1,701,124
1975	2,460,161
1976	1,936,337
1977	2,574,299
1978	3,098,208
1979	4,588,169
1980	4,970,624
1981	4,652,563
1982	4,545,979
1983	3,019,767

*Figures include all fuel oil purchases made by MCPS, some of which were delivered to the Montgomery County Government and Montgomery College.

Construction and Capital Projects, prepared specifications, issued invitations to bid, conducted the formal bid reviews, and awarded the contracts. In FY 1984, MCPS began purchasing fuel oil through a cooperative contract awarded by the Washington Metropolitan Council of Governments (COG). MCPS specifications were included in a joint bid negotiated by Fairfax County on behalf of 14 COG members. (See Appendix A.) The MCPS portion of the contract includes requirements for Montgomery County Government and Montgomery College.

The assumption is that COG should be able, through volume purchasing of almost 20 million gallons, to obtain lower fuel oil prices than could each of its members acting alone; and this assumption was true for FY 1983. However, due to changes in vendor bidding and other factors, the FY 83 discount was not repeated for FY 1984.

The contract awarded for MCPS is different from the contracts of other COG members in that MCPS is the only member that hauls its own fuel oil from vendor distribution points. The Division of Supply and Property Management has been delivering fuel oil for MCPS, Montgomery County Government, and Montgomery College facilities for over 20 years. Only where fuel oil tanks, openings, and/or access space are limited does the vendor make deliveries using smaller vehicles. In FY 1985, MCPS reduced the number of schools on vendor delivery from 39 to 9; and all 9 cases involve auxiliary furnaces, usually serving out buildings.

The same MCPS organizational units have been involved in the fuel oil procurement and distribution processes under both the COG and individual MCPS contracts. The most important of these units are the following:

- Division of Supply and Property Management
- Division of Procurement
- Division of Construction and Capital Projects
- MCPS Sites (schools and other buildings)
- Division of Accounting

Each unit's involvement is described briefly in the following sections, and the overall process is presented graphically in Appendix B.

Division of Supply and Property Management

The Division of Supply and Property Management has the responsibility for ensuring the delivery of fuel oil to schools and other buildings in a timely and efficient manner. The division operates and maintains three tankers used to make fuel oil deliveries during the heating season. Exhibit 2 shows that 95 percent of all deliveries were made during the six-month period from November to April.

Exhibit 3 presents data on the number of gallons delivered per delivery. Most deliveries are full drops (delivery of the total contents of a tanker - 6,300 gallons).

EXHIBIT 2

Frequency of Delivery*

Calendar Period	Percentage of Total Deliveries
July-August	2
September-October	1
November-December	26
January-February	43
March-April	26
May-June	2

* Based on a sample of 192 deliveries to 31 MCPS locations.

EXHIBIT 3

Amount of Delivery*

Size of Delivery (Gallons)	Percentage of Total Deliveries
Under 1,000	3
1,001 - 2,999	19
3,000 - 3,999	8
4,000 - 4,999	6
5,000 - 5,999	9
Over 6,000	56

* Based on a sample of 192 deliveries to 31 MCPS locations.

The daily activities of the fuel oil tanker drivers are scheduled and supervised by the distribution supervisor. Although the delivery system is based on requests made by individual sites, drivers are in contact with their supervisor and can be directed to alternate locations in the event of emergency needs. If the distribution supervisor has not received a request from a location within a given period of time, division staff will contact the responsible school personnel to inquire about the status of their fuel oil supply.

At the end of the heating season fuel oil tanks are topped off--i.e. the fuel oil storage tanks are filled to prevent condensation and related problems over the summer.

Division of Procurement

The Division of Procurement prepares the MCPS fuel oil contract requirements with the assistance of the Divisions of Construction and Capital Projects and Supply and Property Management. The division then negotiates with other COG members, coordinated by the Fairfax County Government, before the total COG bid is advertised and awarded. The division is also responsible for monitoring price changes provided for in the fuel oil contract.

Individual Schools and Other Buildings

At each MCPS facility, one person is responsible for measuring the amount of fuel oil, determining the need for additional oil, and placing a telephone request to the Division of Supply and Property Management. In elementary and junior high schools, building service managers usually exercise this responsibility; in senior high schools, it is usually the plant equipment operators.

Although most MCPS furnaces have meters that measure fuel oil consumption, stored fuel oil is measured in school oil tanks by means of a stick, calibrated in inches, which is lowered into the tank. The amount of fuel oil is determined by a formula based on the depth measurement. Use of the measuring stick provides an opportunity to note the amount of sludge or sediment in the tank, as the appearance of accumulated solid matter is evident on the stick. When required, the Division of Maintenance is contacted to clean the tank.

The need for a delivery is determined by the size of the fuel oil storage tank and the amount of oil in the tank. Exhibit 4 shows that requests for fuel oil are made most often when storage tanks are about half full. Relatively few schools wait until tanks are one-quarter full, and all of those that do wait are elementary schools.

Once the request for a fuel oil delivery has been made by the person at the school, his/her formal responsibility ends. Neither this person, nor any other school-based person, has the responsibility of verifying that the amount of fuel oil requested was delivered. For those few buildings serviced by the vendor, deliveries are made on an automatic fill basis without requests being made by MCPS staff.

EXHIBIT 4

Percentage of Requests for Fuel Oil Delivery at Various Tank Levels by Type of School

Storage Tank Amounts	Total	Elementary	Junior	Senior
Tank 1/2 Full	53	42	78	60
Tank 1/4 Full	34	46	22	0
Tank less than 1/4 Full	5	8	0	0
Other	8	4	0	40

Division of Construction and Capital Projects

The Energy Management Unit in the Division of Construction and Capital Projects monitors fuel oil prices and, to the extent possible, suggests when fuel oil deliveries can be delayed or accelerated to take advantage of lower prices. The division's collection and analysis of statistics support the annual preparation of fuel oil usage forecasts and provide the bases upon which the efficiency of each school's usage is determined. This division also works with the Division of Procurement to prepare fuel oil bid specifications.

Division of Accounting

The Division of Accounting is responsible for compiling and reconciling the fuel oil delivery tickets, prepared by the Division of Supply and Property Management at the time of a request for delivery is made, with the invoices sent to MCPS by the fuel oil vendor. This division also issues payment to the vendor.

Findings and Conclusions

The current procedures for ordering and delivering fuel oil are generally well managed. However, the following four aspects of the procedures deserve further discussion.

Ordering Fuel Oil at Individual Schools

Written guidelines to instruct school-based personnel when to order a fuel oil delivery have not existed since June, 1975, when the former Administrative Regulation 235-2, Fuel Oil Service, was voided. Supply Division managers point out that the provisions of the former regulation are still a part of the required in-service courses which plant equipment operators and building services staff who are responsible for operating the boilers must take. These provisions call for secondary schools to order fuel oil when tanks are at 50 percent of capacity and elementary schools to order at 30 percent of tank capacity.

Material presented verbally as part of a course, which some MCPS personnel may have taken years ago, is not a substitute for written guidelines. The data in Exhibit 4 show that 42 percent of the elementary schools request fuel oil before the unwritten guidelines require them to, a situation which may result in additional trips to the same locations or the delivery of less than a full tanker load to a single location. Although some partial deliveries (less than 6300 gallons) are necessary due to those elementary schools with small storage tank capacity, partial deliveries are inefficient.

On the other hand, 22 percent of the junior-intermediate schools and 40 percent of the high schools fail to observe the secondary guideline and order later than required. While the need for ordering when tanks are still 50 percent full may be questionable, the overall picture which emerges is that many schools are not following the ordering procedures, either because the procedures are not written and available or because they are not enforced.

One corrective action which could be taken immediately is to publish and enforce written guidelines for school-level personnel to follow in ordering fuel oil deliveries. In order to strike a balance between (a) the need to have sufficient fuel oil on hand when ordering to last until delivery and (b) the efficiency of delivering a full tanker load whenever possible, the written guidelines should be based on tank capacities rather than on type of school. However, this solution would continue the dependency on school personnel and would still rely on rough estimates of tank levels determined by the stick method.

Nearly all fuel oil deliveries made by vendors, whether to schools or homes, are on an automatic delivery basis. The vendor determines delivery schedules based on degree days of weather and other indicators. This procedure appears to be satisfactory and would relieve school based personnel from the responsibility for requesting fuel oil deliveries.

The Division of Supply and Property Management currently performs some monitoring of fuel oil use in order to follow up to schools which fail to request deliveries. The Energy Management Unit monitors usage in all schools for budgetary and conservation purposes. These monitoring activities should be merged, expanded, and become the basis for an automatic delivery system like those used by commercial vendors.

Receiving Fuel Oil at Individual Schools

The existing Fuel Oil Ticket, if it were signed by someone at the receiving school, would provide adequate control procedures to ensure that a scheduled fuel oil delivery is made. However, adequate control procedures for validating the amount of fuel oil actually delivered are not currently used.

Although building service managers must use a stick to measure the level of fuel oil on hand, they are not required to perform a stick estimate following a fuel oil delivery. The MCPS tanker drivers use calibrated markers inside the tankers to estimate the amount of oil delivered by comparing the amount of fuel oil loaded at the vendor's terminal and the amount remaining in the tanker after delivery. No audit trail results from these estimating methods. Neither fuel oil storage tanks nor MCPS delivery trucks have meters or gauges to determine the exact amount of fuel oil delivered.

Fuel oil meters have been installed in the boiler rooms at a majority of schools as part of the energy management program. However, because these meters are located between the storage tank and the burner, they measure the consumption of fuel oil. They are not well suited to, and are rarely used for, internal control purposes in conjunction with the delivery of fuel oil.

Since there currently is no reliable way of knowing how much fuel oil is actually delivered, managers lack accurate data which can later be compared to usage data for monitoring purposes; and the opportunity for fraud is present.

The immediate solution to this lack of internal control would be to require the building services manager or school plant operator to measure the tank levels by stick immediately before and after each delivery. An estimated amount for the delivery could then be recorded on the Fuel Oil Ticket, which should be returned to the Division of Supply and Property Management by the school person, not with the tanker driver. This solution would still rely on an estimate and would place an added responsibility on the school-based personnel.

A more satisfactory solution would be the use of a metering device on each tanker to record automatically on the Fuel Oil Ticket the amount of fuel oil unloaded. This procedure would generate the same type of record which MCPS now requires of the vendor when fuel oil is loaded into the tankers at the vendor's terminal.

Although the exact cost of such meters cannot be determined until specifications are submitted to the competitive bidding process, a telephone

contact with one firm, Petroleum Services, Inc. of Baltimore, provided an estimated cost for each meter of approximately $2,100, plus an installation charge of $200. Therefore, MCPS' one-time investment to equip three tankers would be $6,900. (Even if the fuel oil managers' higher estimate of close to $20,000 total cost for the meter installation were to prove correct, this is a relatively low cost control mechanism when compared to the $4 million annual expenditure for fuel oil.)

Topping Off

The 1982 Review of Procurement Practices in the Montgomery County Public Schools, completed by Touche Ross & Co., determined that the reasons for topping off fuel oil tanks in the spring were that (1) it is "normal practice in industry," (2) it "prevents condensation," and (3) there is "money in the budget." The study also found that the practice of topping off in the spring caused an early expenditure of approximately $704,000 in FY 1982. If the expenditure for this oil could be delayed until needed in late fall, approximately $35,000 of additional revenue from interest payments could have been obtained by the Montgomery County Government (based on a 10 percent rate of return).

This estimate assumes fuel oil will be available in the fall at the same price per gallon as in the spring. In a period of rising prices, part or all of these savings could be offset by the increased cost to purchase the same quantity of oil in the fall. In a period of declining oil prices, additional savings would accrue from delayed purchasing.

Because this issue was raised, but not resolved, in the Touche Ross study, the question of the need for topping off tanks was examined in this study.

From an operational standpoint, the most important reason for topping off seems to be the prevention of condensation. Telephone interviews with representatives of four other Maryland school systems and four oil industry organizations confirmed the necessity of this practice. The only suggested alternatives to topping off were to run the tank dry (empty) or drain the tank in the spring. Prior to filling the tank in the fall, however, the water collected in the empty tank through condensation must be drained. Additional maintenance expenses are associated with these alternative procedures.

Therefore, the topping off process appears to be justified and should be continued unless there is strong reason to believe that fuel prices will drop sharply in the near future.

Overall Procedures and Processes

Major responsibility for managing fuel oil procurement, delivery, and usage is divided among three separate MCPS units: (1) the Division of Procurement, (2) the Division of Supply and Property Management, and (3) the Energy Management Unit in the Division of Construction and Capital Projects. The administrative procedures for monitoring this $4 million annual expenditure are largely informal, unwritten, and sometimes overlapping. One

example is monitoring fuel oil prices. The Energy Management Unit monitors price fluctuations for budgetary purposes and to advise the Division of Supply and Property Management when to advance or delay fuel oil deliveries. The Division of Procurement has responsibility under all MCPS contracts to monitor and approve price changes.

MCPS should formalize in writing the procedures for managing this large account, from cost analyses and budgetary forecasting through procurement to usage, so that there is no duplication of effort among units.

CHAPTER 2

COMPUTER-ASSISTED MODELS FOR MONITORING FUEL OIL PURCHASING, DELIVERY, USAGE, AND EXPENDITURES

Introduction

Chapter 1 discussed the current processes for the procurement and delivery of fuel oil in MCPS. Although with a few exceptions those processes are generally well managed, they do not take advantage of some of the available, relatively inexpensive technology for monitoring and analysis. Therefore, DEA staff designed two computer models as examples of the type of support which could be made available to managers for improved decision making.

The first model provides a framework for decision making in considering the alternatives for the procurement and delivery of fuel oil. The second model monitors current usage, price, and expenditures for fuel oil. Both models were developed using the SuperCalc 2 spreadsheet package on a Kaypro IV microcomputer. However, other combinations of similar software and hardware are just as feasible for this level of modeling.

Test runs of these models, using FY 1984 data, suggest some overall recommendations for the fuel oil procurement and delivery process.

The Procurement/Delivery Model

Each year MCPS staff must determine how the necessary fuel oil will be procured and delivered. No formal, standardized procedures exist for making these decisions. The informal process is manual; and although it includes consideration of as many factors as possible, various "What if?" situations cannot be easily evaluated.

What is needed is a computer-assisted simulation model which incorporates all of the major elements - personnel, equipment, and financial resources - which determine the cost of providing fuel oil to MCPS facilities under varying circumstances. The elements should be standardized and account for differences in the cost of various alternatives. An example of such a model is summarized here and presented in greater detail in Appendix C.

Possible Alternatives for Purchase and Delivery

The primary options available to MCPS for the purchase of fuel oil are (1) participation in the COG joint bid or (2) an individual MCPS bid; and the options associated with delivery are (1) MCPS hauling or (2) vendor hauling. When combined, the two purchase options and two delivery options create the following four alternatives:

- Alternative A, COG purchase and MCPS hauling, which depicts current MCPS fuel oil purchase and delivery practice
- Alternative B, MCPS purchase and hauling, which was used by MCPS between FY 1961 and FY 1983
- Alternative C, COG purchase and vendor hauling, which has never been tried by MCPS, but is currently used by all other school systems participating in the COG joint fuel oil procurement
- Alternative D, MCPS purchase and vendor hauling, which was used by MCPS prior to FY 1961

Major Cost Components

The three cost components evaluated by the model are the following:

1. Purchase price of the fuel oil from the vendor, which can vary twice monthly based upon an industry oil index
2. Cost of delivering fuel oil to schools
   a. If the vendor delivers, included in the purchase price
   b. If MCPS delivers, a combination of (1) drivers' salaries, (2) overtime salaries, (3) fixed charges, (4) vehicle maintenance and operating costs, and (5) vehicle depreciation
3. Impact of the Montgomery County fuel oil tax

Assumptions Underlying Assessment of Alternatives

A critical aspect of modeling is the consistent use of standard assumptions and methods of calculating cost components. This decision model was based on the following assumptions:

- MCPS, bidding alone, would not be able to improve upon either the purchase-only or purchase-and-deliver fuel oil prices obtained by COG.

- o MCPS can not easily move annually into or out of the fuel oil hauling program, and longer-term decisions should be made.

- o COG will continue to function as an agency for the joint procurement of fuel oil.

- o Fuel oil for the 39 schools with small tank capacities or limited access will be purchased from and delivered by the vendor.

These assumptions should be verified periodically. For example, the first assumption has the effect of eliminating Alternatives B and D, under which MCPS does its own fuel oil purchasing. In FY 1983 that was a sound assumption. In FY 1984 the volume discount was considerably smaller, and the assumption less certain. Depending on the bid-price trend over a longer period and the degree to which MCPS wants to encourage minority and small firms to bid, that assumption may need to be changed.

The last assumption was affected by the decision, beginning in FY 1985, to have MCPS haul fuel oil to 30 of the 39 school locations previously supplied by vendor delivery. The effect of this decision on the FY 1984 simulations used for this report is discussed later in this chapter.

Layout of the Model

The "model" is actually a matrix with the 24 price periods of the COG contract (two periods for each month) and a "total" column identified across the top of the matrix and the procurement/delivery alternatives to be priced listed down the left side. Each run of the simulation model fills in the cells of the matrix by calculating the per-period and total cost for each alternative. (See Appendix C for an example of the matrix and typical data calculation formulas.)

The alternatives in the left column may be any of the procurement/delivery choices identified earlier or may pose "What if?" type questions within any of the procurement/delivery choices. For example, "What is the effect on MCPS costs if usage were to increase five percent under Alternative A, COG purchase, MCPS haul?" "Is the effect on cost the same under Alternative C, COG purchase, vendor haul, when usage increases five percent?"

The Usage/Price/Expenditure Model

Although similar in construction to the procurement/delivery model, the purpose of the usage/price/expenditure model is to assist the Energy Management Unit in the Division of Construction and Capital Projects to (1) monitor the "fiscal year-to-date" usage, price, and dollar expenditures for fuel oil; (2) project these same data through the end of the current fiscal year under various assumptions about operating and weather conditions; (3) assist the preparation of the fuel oil portion of the operating budget for the following fiscal year; and (4) respond to Board and managers' requests for financial data and "What if?" situations.

The suggested model is summarized here and presented in greater detail in Appendix D.

Elements of the Model

For each category of fuel oil and price period, the model identifies, as appropriate, the following elements:

- Projected usage (beginning of year projection)
- Actual usage
- Projected vs. actual usage

- Projected price (beginning of year)
- Actual price
- Projected price vs. actual price

- Projected expenditures (beginning of year)
- Actual expenditures (to date)
- Projected vs. actual expenditures

- Updated projection of usage (for remainder of year)
- Updated projection of price (for remainder of year)
- Updated projection of expenditures

Assumptions Underlying the Model

This simulation model is based on the following assumptions:

- Decisions concerning fuel oil procurement and delivery have already been made, and this model can be used under any of the four alternatives for procurement/delivery discussed above.

- MCPS will continue to purchase and use both No. 2 and No. 5 fuel oils.

- Eventually, MCPS will want to enter actual price and usage data twice each month to correspond to the 24 contract price adjustment periods. (Some data is currently available only monthly.)

Layout of the Model

This model is also a matrix, with the 24 price periods of the COG contract and a total column across the top. Down the left side of the matrix are the specific data elements listed above for both categories of fuel oil, No. 2 and No. 5. At the beginning of a fiscal year, the cells of the matrix are filled with projected data. As each of the price adjustment periods passes, actual data is substituted for the projected data; and new year-end totals are calculated automatically.

The matrix also permits the user to (1) enter more refined projections at any point during the year for the remaining price periods, (2) determine the effect on year-end expenditures, and (3) pose "What if?" questions for the remainder of the year to see the effect on total expenditures. For example, "If the price of fuel oil over the last six months of the year is six percent lower than projected, but usage increases by an unpredicted three percent due to colder weather in March and April, what will MCPS fuel oil expenditures be?" (The model's detailed logic and calculations can be examined in Appendix D.)

Application of the Procurement/Delivery Model

The computer-simulation procurement/delivery model described above was run to evaluate the cost differences for Alternative A (COG purchase, MCPS delivery) and Alternative C (COG purchase, vendor delivery) under various usage and price conditions for FY 1984. The model used actual cost, price, and usage data which was available at the time of the run and projected what was not available. The results are summarized on Exhibit 5 and presented in greater detail in Appendix E. The impact of the decision to haul fuel oil to additional schools beginning in FY 1985 is discussed in the "findings" section.

Findings

Row 9 of Exhibit 5 shows that the model's cost of Alternative A (MCPS delivery) for FY 1984 was approximately $3,274,000; and the cost of Alternative C (vendor delivery under the COG contract) would have been approximately $3,260,000. The difference of $14,000 represents a modest savings theoretically available to MCPS had it used vendor delivery.

However, under the vendor delivery alternative, Montgomery County Government would have collected $54,600 in FY 1984 from the fuel oil tax, which is only assessed on vendor delivered oil. Vendors do not include the cost of the fuel oil tax in the price per gallon, but rather invoice the customer separately for the tax. However, the amount of the tax is included in the simulation model and requires no additional expenditure calculation--i.e. MCPS would have saved the $14,000 after paying the tax. But, the added revenue to Montgomery County from the tax is not a part of the model and represents an addition to the overall county budget. Therefore, the net gain to the county under Alternative C would have been $68,700. If the county elected to appropriate the added revenue from the fuel oil tax to MCPS, its net gain would also have increased from $14,000 to $68,700.

One of the advantages which a computer simulation model has over manually-calculated projections is the ability to handle a variety of different assumptions about future conditions. Exhibit 5 includes the results of running the procurement/delivery simulation model under various combinations of "What if?" conditions for fuel oil usage and price. The objective of these additional simulation runs is to test whether the

EXHIBIT 5

Analysis of What If Cases For Alternatives A and C For FY 1984

What If Conditions	Cost Alt.A (MCPS Deliver)	Cost Alt.C (COG Deliver)	Diff.Alt. A & C (MCPS Savings)	MC Tax Paid By Alt. C	Net Gain To Govt.
Actual FY 1984	3,274,015	3,259,904	14,111	54,627	68,738
1% usage increase Dec.-March same fuel oil prices as of FY 84	3,298,708	3,285,246	13,462	55,047	68,509
3% usage increase Dec.-March same fuel oil prices as FY 84	3,427,337	3,417,196	10,141	57,185	67,326
5% usage increase Dec.-March same fuel oil prices as FY 84	3,478,362	3,469,561	8,801	58,050	66,851
10% usage increase Dec.-March same fuel oil prices as FY 84	3,605,922	3,600,474	5,448	60,214	65,662
15% usage increase Dec.-March same fuel oil prices as FY 84	3,733,482	3,731,386	2,906	62,377	64,473
20% usage increase Dec.-March same fuel oil prices as FY 84	3,862,299	3,861,043	1,256	64,540	65,796
21% usage increase Dec.-March same fuel oil prices as FY 84	3,886,555	3,888,481	-1,926	64,973	63,407
Same usage as FY 84 1% price increase Dec.-March	3,285,225	3,271,115	14,110	54,627	68,737
Same usage as FY 84 10% price increase Dec.-March	3,520,945	3,506,835	14,110	54,627	68,737
1% usage decrease Dec.-March same fuel oil prices as FY 84	3,315,289	3,312,466	12,823	55,454	68,277
3% usage, decrease Dec.-March same fuel oil prices as FY 84	3,274,265	3,260,100	14,165	54,588	68,753
5% usage decrease Dec.-March same fuel oil prices as FY 84	3,249,878	3,235,008	14,870	54,131	69,001
10% usage decrease Dec.-March same fuel oil prices as FY 84	3,095,680	3,076,822	18,858	51,560	70,418
15% usage decrease Dec.-March same fuel oil prices as FY 84	2,968,119	2,945,910	22,209	49,396	71,605
20% usage decrease Dec.-March same fuel oil prices as FY 84	2,840,558	2,814,997	25,561	47,233	72,794
same usage as FY 84 1% price decrease Dec.-March	3,249,322	3,235,211	14,111	54,627	68,738
Same usage as FY 84 5% price decrease Dec.-March	3,150,549	3,136,439	14,110	54,627	68,737

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apparent FY 1984 net savings under vendor delivery would prove true under different circumstances. For each case, the exhibit shows: (1) the cost of Alternative A, (2) the cost of Alternative C, (3) the difference between them, (4) the amount of fuel oil tax paid to Montgomery County under Alternative C, and (5) the net gain to the overall county budget.

An analysis of the data in Exhibit 5 provides the following findings:

- If usage had increased (e.g., a colder winter or relaxed conservation efforts) and fuel oil prices had remained the same,
  - The direct savings to MCPS from vendor delivery would have decreased.
  - The tax revenue to the county government would have increased.
  - The break-even point for direct savings to MCPS would have occurred at a 20 percent usage increase.
  - Because the decreased MCPS direct savings is always balanced by increased revenue to the county, the net gain to the county (and possibly to MCPS) remains about the same.
- If usage had decreased (e.g., a warmer winter or greater conservation) and fuel oil prices had remained the same,
  - The direct savings to MCPS from vendor delivery would have increased.
  - The tax revenue to the county government would have decreased.
  - At a 20 percent usage decrease, the direct savings to MCPS would have been $25,561.
  - Again, because of the offsetting trends, the net gain to the county stays about the same.
- If fuel oil prices had changed, either increased or decreased, there would have been no effect on the cost differences between Alternatives A and C.

Running these various simulations shows that, based on FY 1984 data, it would be financially advantageous under nearly all circumstances for MCPS to cease hauling its own fuel oil. However, during this study, managers of fuel oil procurement and delivery identified four questions, the answers to which they indicated were important to the decision process and should, therefore, be considered before drawing any conclusions about future years. These questions are the following:

- Who (MCPS or an outside contractor) has the primary responsibility for ensuring that the instructional program is not adversely affected by the unavailability or delayed delivery of fuel oil, and is this responsibility better met by MCPS staff or the vendor?

- Who has control of the timing of fuel oil deliveries, and can this control (ability to speed up or delay deliveries based on price trends) be advantageous to the vendor or MCPS?

- How frequently can MCPS obtain fuel oil usage and expenditure data for account monitoring and conservation purposes, and how timely will the data be when received?

- How does the amount of paperwork compare for MCPS delivery and vendor delivery?

These four questions are addressed in the following sections.

Responsibility for Uninterrupted Deliveries

Under the current MCPS delivery arrangement, schools request fuel oil deliveries directly from the Division of Supply and Property Management, and that division has the primary responsibility to ensure that the instructional program is not affected by the unavailability or delayed delivery of fuel oil. Under the vendor-haul alternative, that responsibility passes to the vendor.

The study surveys of MCPS principals and other school-based personnel revealed no significant interruptions of the instructional program due to fuel oil delivery problems by the Division of Supply and Property Management. Discussions with other school systems using vendor delivery of fuel oil indicated that their experiences with the responsiveness of vendors are also very positive. At no time have the instructional programs been interrupted due to the unavailability of fuel oil.

Therefore, while the importance of prompt, responsible deliveries must be stressed under either hauling option, there is no evidence to suggest that this factor discriminates between the alternatives.

Timing Deliveries for Financial Advantage

MCPS managers are concerned that the vendor has a profit motive to either speed up or slow down the deliveries to achieve a price advantage. Conversely, when MCPS performs the deliveries, it can speed up or slow down the process to minimize its expenditures. Managers report that price variations of five cents per gallon are typical during the March to June period when 30 percent of the total fuel oil requirement is purchased. The managers believe that manipulations by MCPS, especially during the April to June topping off period, have saved money in past years.

Two points are involved here: (1) the degree to which the opportunity for delivery manipulation is present and (2) the extent to which either MCPS or the vendor is likely to use the opportunity to its advantage.

Price changes are contractually limited to twice a month. During the regular heating season, the constant demand for fuel oil allows only a few days

leeway in responding to a delivery request. (The same unwritten guidelines cited earlier as continuing from former regulation 235-2 specified deliveries should be made within 48 hours of a school's request.) Therefore, only two periods of a few days exist each month when the timing of deliveries could take advantage of price fluctuations.

The more significant opportunity for manipulating deliveries is the period at the end of the heating season when fuel tanks need to be topped off, but response time for keeping the schools heated is not a factor. If a substantial fluctuation in the price of fuel oil occurs during this period, an opportunity exists for MCPS savings or vendor profit.

An example of this latter situation occurred during the topping-off period in FY 1983 when the price of fuel oil increased through the April to June period. At that time, Fairfax County Public Schools had fuel oil delivered by the vendor under the COG contract (vendor control), while MCPS hauled its own fuel oil (MCPS control). Data on the percentage of total year fuel oil deliveries made during each of the three topping-off months were obtained for both school districts and compared. The graphs in Exhibit 6 show that for Fairfax the peak topping off of the tanks by the vendor occurred in April, when prices were lowest, and tapered off during May and June. In contrast, the peak topping-off activity for MCPS came in May when prices were highest and, for No. 5 fuel oil, continued into June.

Data for a single year are not sufficient to confirm or deny vendor opportunity and motivation to manipulate deliveries for greater profit. Nor does this one example establish whether either the vendor or MCPS had correctly predicted price changes. Nevertheless, the example suggests caution regarding the assumptions that (1) the vendor has the opportunity and the motivation to manipulate deliveries for its own profit and (2) MCPS can act to maximize savings during the topping-off period when a vendor would not.

Control of Financial Information

The annual MCPS expenditure for fuel oil is substantial and can fluctuate from month-to-month. Therefore, MCPS management and the Board of Education must have accurate and timely fuel oil usage and expenditure data on which to base operating budget decisions during the year. Daily fuel oil delivery and invoicing data are important to this monitoring activity. MCPS fuel oil managers believe the MCPS hauling program provides more timely delivery data to the Energy Management Unit than does vendor delivery, which normally results in a single monthly invoice.

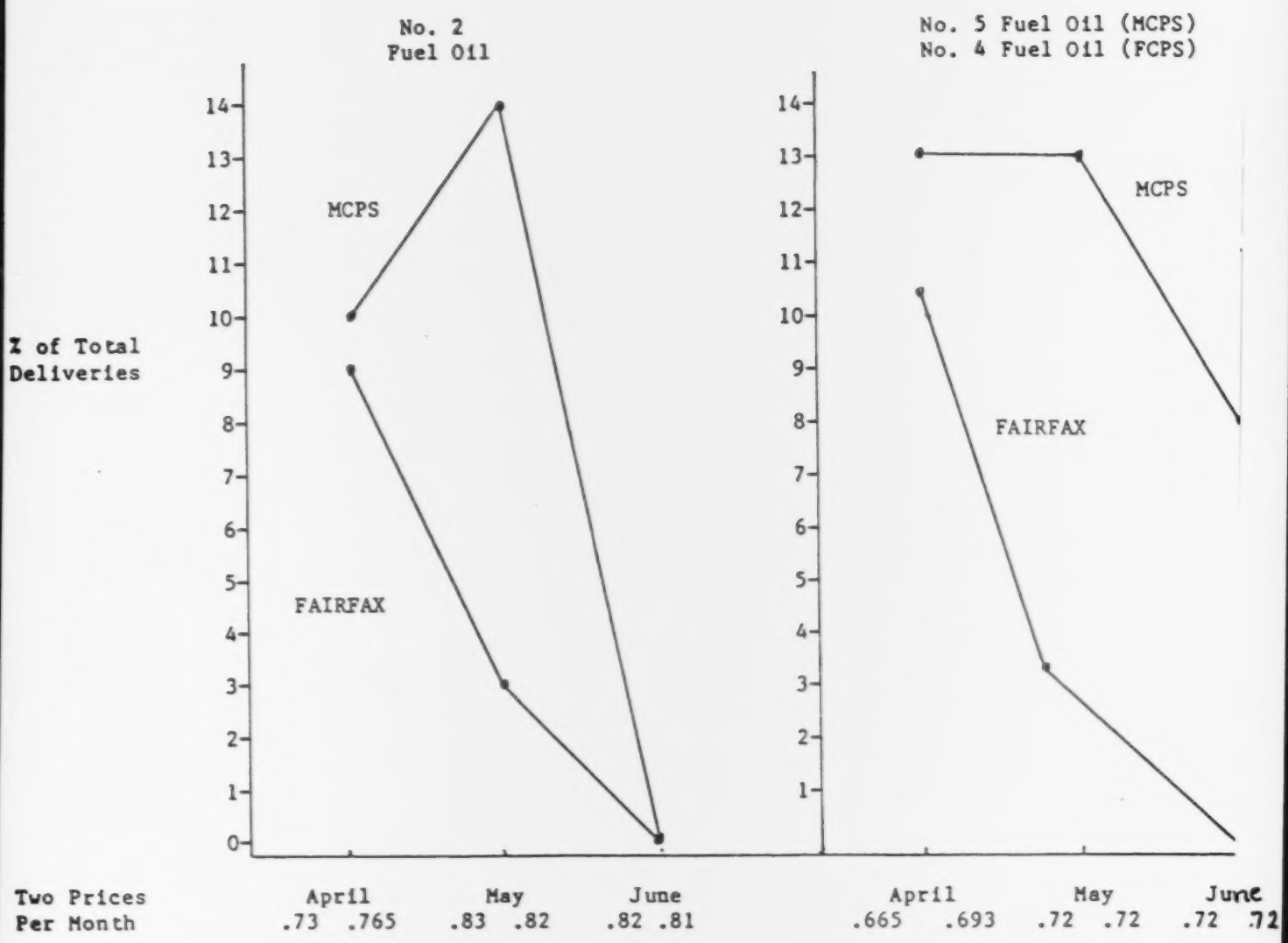
One solution to this problem would be to have school personnel forward the customer copies of the commercial delivery tickets to the Energy Management Unit immediately following each delivery. The metered amount of fuel oil delivered could be entered into the usage/price/expenditure simulation model described earlier at the last identified price-per-gallon for monitoring purposes. When the vendor's monthly invoice is received, the model could retroactively adjust for any price changes.

EXHIBIT 6

Percent of Total Deliveries vs.

Price for Topping-Off Months of

FY 1983



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Paperwork

Under the current delivery system, each fuel oil delivery results in a fuel oil ticket, which is returned to the Division of Supply and Property Management by the driver. The supply division batches and logs the tickets for its own internal control purposes and then forwards them to the Energy Management Unit, where the data is used for energy monitoring purposes. Energy Management, in turn, forwards the tickets to the Division of Accounting, where they are matched against the vendor's invoice before payment. (See Exhibit B-1, Appendix B, for a graphic presentation of this process.)

The findings presented in Chapter 1 suggest that, for purposes of improved internal control, the current procedures should be modified to verify the amount of fuel oil delivered at each location and to have school personnel, rather than the driver, return the fuel oil tickets.

Under vendor delivery, the paper flow is nearly the same. Each vendor delivery would result in a fuel oil ticket, but that ticket would already include the amount of fuel oil delivered. Since the Division of Supply and Property Management would not be involved in the delivery process, school personnel could return the tickets directly to the Energy Management Unit, where the necessary data for monitoring would be recorded. Energy Management would forward the tickets to the Division of Accounting, where a match would continue to be made against the vendor's invoice.

Although managers predict an increase in paper flow under vendor delivery, it is difficult to see how the increase would come about. The new responsibility for schools to return the fuel oil tickets is needed under either delivery system. The role of the Division of Supply and Property Management in logging the delivery tickets against tanker pick-up and delivery records is transferred to the vendor. The rest of the process remains about the same and would occur with about the same frequency.

Discussion and Recommendations

Fuel Oil Delivery

The findings in this study suggest that vendor delivery of fuel oil may be a cost-effective alternative to the MCPS hauling program for the following reasons:

- Based on the FY 1984 data, savings in the range of $10,000 to $20,000 would occur to MCPS from vendor delivery under nearly all price and usage conditions.
- Because of payment of the fuel oil tax, revenue increases in the range of $50,000 to $65,000 occur to the county government from vendor delivery under the same price and usage conditions, with the net gain to the overall local government budget being as high as $70,000.

- The one-time cost of at least $7,000 to equip the MCPS tankers with flow meters for better internal control would be avoided, as would the cost of developing or buying an automated fuel oil delivery system.

- The number of positions carried in the operating budget would be reduced because fewer drivers would be required in the Division of Supply and Property Management. (The exact number of positions would be determined after assessing the most efficient way to meet non-fuel-oil delivery needs outside the heating season.)

- The responsibility of school personnel for ordering fuel oil would be eliminated.

- The number of major MCPS units involved in managing the fuel oil processes would be reduced by one-third since the Division of Supply and Property Management's only fuel oil responsibility is the MCPS hauling program. The Divisions of Procurement and Construction and Capital Projects would share the remaining responsibilities.

- The sale of the existing tankers would produce a modest, one-time increase in revenue.

In addition, three of the four issues raised by MCPS managers--responsibility for noninterruption of the instructional program, control of delivery times so as to optimize price considerations, and the amount of paperwork--do not necessarily discriminate between the MCPS and vendor hauling programs and cannot be considered a certain advantage or disadvantage for either delivery alternative.

Further, a solution is readily available for addressing the fourth manager issue--timely collection of price and usage data; therefore, this factor is also neither an advantage nor a disadvantage.

It should be noted, however, that, if MCPS elected vendor delivery, the savings to MCPS would not be reflected in the utility accounts. In fact, the fuel oil account would <u>increase</u> because the expenditures would include delivery costs and the energy tax. However, a <u>decrease</u> would show in the budget of the Division of Supply and Property Management, from which the positions and operating costs for MCPS to deliver fuel oil would be deleted. Budget documentation would be required to demonstrate the net savings and to permit consistent utility price comparisons to previous years.

Although the FY 1984 data simulations make the vendor delivery plan appear to be an attractive, cost-effective alternative in nearly all respects, one factor raises an uncertainty. That factor is the break-even point for direct savings to MCPS, which is projected to occur if there is a 20 percent increase in the use of fuel oil <u>for any reason.</u>

The decision that MCPS would start delivering fuel oil in FY 1985 to 30 of the 39 schools which were previously supplied by the vendor has the effect of increasing total fuel oil usage above the amount used in the original study simulations. If the increase is combined with the additional increase

which the new Area 3 schools will require, and if a future winter were colder than FY 1984, total MCPS fuel oil usage could easily be 20 percent greater.

On the other hand, as MCPS salary costs increase for the tanker drivers or if the increased usage should require adding a fourth tanker and driver in a future year, the higher costs of the delivery program might offset the greater oil usage and keep the vendor fuel oil delivery alternative in the cost-effective range.

To examine the combined effects of these possible events, a further simulation was run using the FY 1984 baseline data, but adding the following new assumptions:

- The 30 additional schools added to the MCPS delivery program in FY 1985 will continue to be served by MCPS. Fuel oil use by these schools will be the amount estimated in the FY 1985 bid specifications.

- Over the next five years, MCPS will build six new elementary schools and one new high school. Fuel oil use by these schools will be equal to the average amount currently used by schools at the same grade levels.

- By the end of the five-year period, the additional fuel oil usage will require adding a fourth tanker and driver. Salary and fixed charges for the driver will be equal to the average for the existing three drivers. Operating costs and depreciation for the tanker will be equal to the average of the existing three tankers.

The results of this revised simulation are provided in Exhibit 7 and show that, if all of the assumptions proved to be true, the direct savings to MCPS from changing to vendor delivery would be approximately $23,500, an increase of nearly $10,000 over the $14,000 projected for FY 1984 alone.

Although possible variations in winter temperatures were not included in the revised simulations, an ample "window" exists for such fluctuations since the new break-even point would occur only when MCPS fuel oil usage increased 28 percent above the revised level included in the simulation.

It is important to clarify, however, that the cost effectiveness of vendor delivery is predicated on the MCPS delivery costs increasing at the same time fuel oil usage increases. Although an additional driver and tanker caused the increase in this simulation, substantial salary increases or the use of additional driver overtime could have the same effect. If usage increases without a substantial increase in delivery costs, continued MCPS delivery of its own fuel oil would be more cost-effective.

In all of these simulations, changes in the cost of purchasing fuel oil have no significant impact on the cost effectiveness of the delivery alternatives. Usage and MCPS delivery costs are the two critical variables.

EXHIBIT 7

Results of the Simulation Run

When Future Usage and Additional Delivery Costs Are Added

"What if?" Conditions	Cost of Alternative A (MCPS Delivery)	Cost of Alternative C (Vendor Delivery)	Difference Between A & C (MCPS Savings)
Actual FY 1984 plus projected usage and delivery costs	$3,734,595	$3,711,054	$23,541
10 percent additional usage increase	4,098,861	4,084,861	14,000
20 percent additional usage increase	4,386,341	4,379,924	6,417
28 percent additional usage increase	4,616,324	4,615,974	350
30 percent additional usage increase	4,673,820	4,674,987	(1,167)

Primary Recommendations

The findings of this study suggest the following primary recommendations regarding the procurement and delivery of fuel oil:

- MCPS managers responsible for fuel oil procurement and delivery should develop long-range projections, in as much detail as possible, for continuing MCPS fuel oil usage (based on the Capital Improvements Program, when adopted, and other identifiable factors) and for MCPS delivery costs in relation to the projected usage. The study simulation model and/or any other available supports might be used for assisting with these projections.

- If the projections indicate that future usage will be at least 20 percent greater than for FY 1984 and that MCPS delivery costs to handle the total projected usage will not increase substantially, the alternative of MCPS delivery should be continued.

- If, on the other hand, the projections show corresponding increases in both usage and MCPS delivery costs, conversion to the alternative of vendor delivery should be implemented.

Other Recommendations

In addition to the primary recommendations regarding fuel oil delivery, the following recommendations for improving the current procedures for the procurement and delivery of fuel oil in MCPS should also be implemented:

1. The simulation models described in this chapter (or any other monitoring and projection techniques which can accomplish the same types of objectives--e.g., possibly the Department of Energy X11 model cited by managers when they reviewed this report) should be used by the Energy Management Unit to monitor and project fuel oil usage, price, and dollar expenditures.

2. To facilitate monitoring fuel oil usage, MCPS should establish procedures to collect copies of the fuel oil delivery tickets directly from schools on a daily basis and other fuel oil delivery data by COG price periods.

3. Management procedures for administering the fuel oil procurement, delivery, and usage processes should be clarified, formalized, and issued in writing.

4. The topping-off process should continue as in the past unless the unit responsible for monitoring the price of fuel oil predicts a substantial price decrease between the spring and fall periods.

If the steps listed as "Primary Recommendations" lead to MCPS' continuing its own fuel oil hauling program, the following additional recommendations should be implemented:

1. MCPS should develop and issue to all building services managers and school plant equipment operators written guidelines for determining when to order fuel oil deliveries. These guidelines should be based on tank capacities rather than on school types.

2. On a longer-term basis, MCPS should evaluate an automatic delivery and fill system which would substantially eliminate school-based responsibility for ordering fuel oil.

3. Fuel oil delivery procedures should be modified to require a school-based staff member to verify fuel oil deliveries and estimate the amount delivered. The record of the delivery and amount should be returned directly to the Division of Supply and Property Management, not through the truck driver.

4. As a more adequate control and data device, MCPS should install flow meters on the delivery tankers.

APPENDICES

APPENDIX A

Government Agencies Participating in the

Washington Area Council of Governments (COG)

Fuel Oil Procurement

FY 1984

In FY 1984 COG purchased fuel oil for following 14 agencies:

1. Arlington County
2. Alexandria Sanitation Authority
3. City of Alexandria
4. City of Bowie
5. City of Rockville
6. City of Fairfax
7. City of Gaithersburg
8. County of Fairfax
9. Maryland-National Capital Parks and Planning Commission
10. Montgomery County/Montgomery County Public Schools
11. Prince George's County
12. Prince George's County Public Schools
13. Prince William County
14. Washington Metropolitan Area Transit Authority

APPENDIX B

The Work Process and Relationships Involved in MCPS Fuel Oil Purchase and Distribution

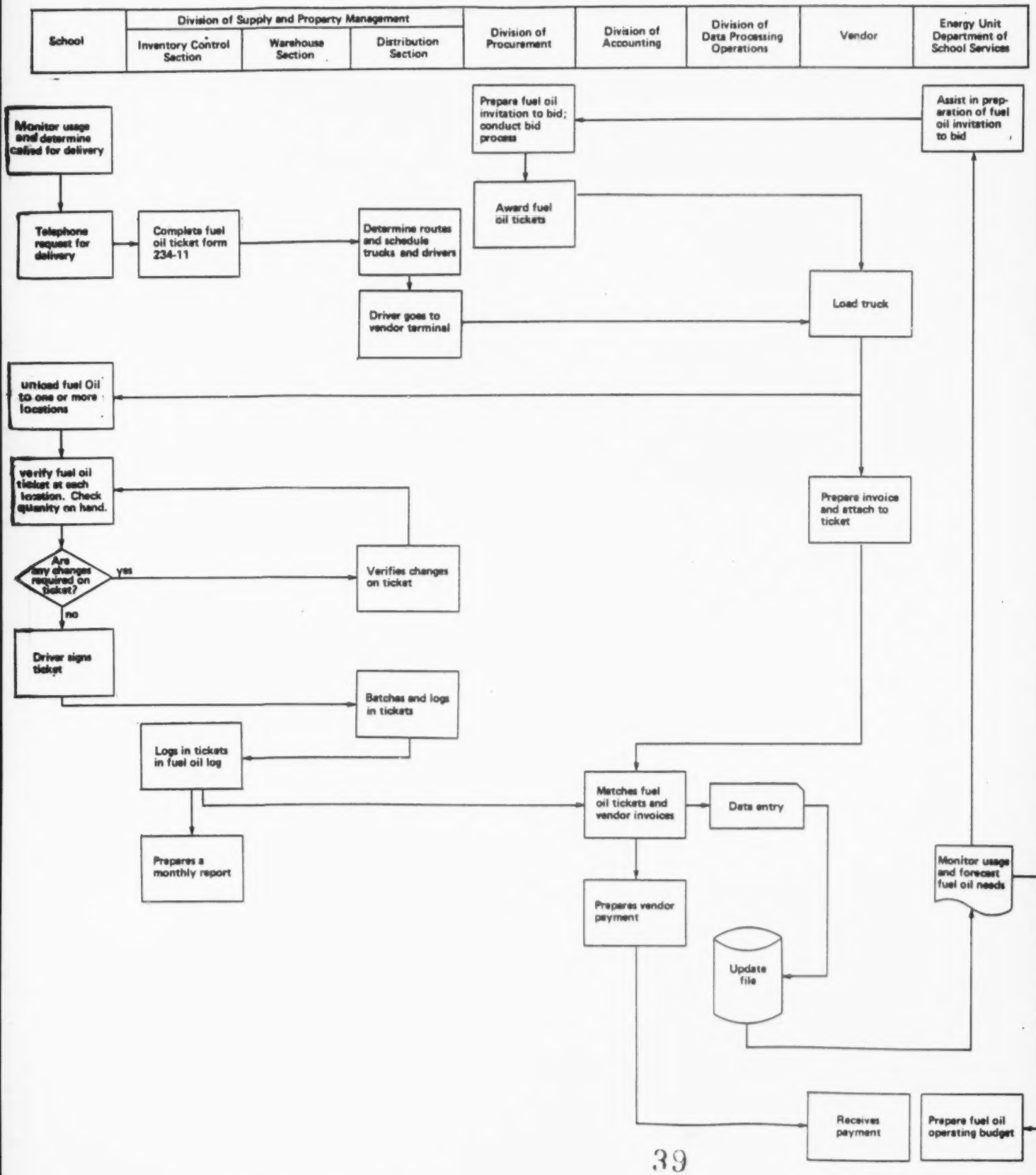
The same MCPS organizational units have been involved in the fuel oil procurement and distribution processes under both the COG and individual MCPS contracts. The most important of these units are the following:

- Division of Supply and Property Management
- Division of Procurement
- Division of Construction and Capital Projects
- MCPS sites (schools and other buildings)
- Division of Accounting

Exhibit B-1 is a graphic representation of the work processes and relationships involved in fuel oil purchase and distribution. The activities conducted by each organizational unit in the process are presented without notation as to frequency of occurrence. Some tasks, such as the preparation of the fuel oil operating budget and the contract award, are conducted on an annual basis. Other activities, such as vendor payment and monthly report preparation, take place monthly. Most of the activities involving individual schools and the Division of Supply and Property Management take place daily during the heating season.

Exhibit B-1

Work Process Flow for Purchase and Distribution of Fuel Oil


School
Division of Supply and Property Management
Inventory Control Section
Warehouse Section
Distribution Section
Division of Procurement
Division of Accounting
Division of Data Processing Operations
Vendor
Energy Unit Department of School Services
Monitor usage and determine called for delivery
Telephone request for delivery
Complete fuel oil ticket form 234-11
Determine routes and schedule trucks and drivers
Driver goes to vendor terminal
Prepare fuel oil invitation to bid; conduct bid process
Award fuel oil tickets
Assist in preparation of fuel oil invitation to bid
Load truck
unload fuel Oil to one or more locations
verify fuel oil ticket at each location. Check quanity on hand.
Are any changes required on ticket?
yes
no
Verifies changes on ticket
Driver signs ticket
Batches and logs in tickets
Logs in tickets in fuel oil log
Prepares a monthly report
Prepare invoice and attach to ticket
Matches fuel oil tickets and vendor invoices
Data entry
Preparas vendor payment
Update file
Monitor usage and forecast fuel oil needs
Receives payment
Prepare fuel oil operating budget

39

APPENDIX C

The Procurement/Delivery Simulation Model

Each year MCPS staff must determine how the necessary fuel oil will be procured and delivered. No formal, standardized procedures exist for making these decisions. The informal process is manual; and although it includes consideration of as many factors as possible, it cannot easily evaluate various "What if?" situations.

What is needed instead is a computer-assisted simulation model which incorporates all of the major elements--personnel, equipment, and financial resources--which determine the cost of providing fuel oil to MCPS facilities under varying circumstances. The elements should be standardized and account for differences in the cost of various alternatives.

Description of Possible Alternatives

The purpose of this section is to describe the various alternatives which should be included in the model so that managers can determine the best method of procuring and delivering fuel oil to MCPS schools and other facilities. In establishing standard criteria for the assessment of alternatives, the fuel oil procurement and delivery activities must be clearly defined in terms of options that lead to mutually exclusive alternatives.

The primary options available to MCPS for the purchase of fuel oil are (1) participation in the COG joint bid or (2) an individual MCPS bid, and the options associated with delivery are (1) MCPS hauling or (2) vendor hauling. When combined, the two purchase options and two delivery options create four distinct alternatives. The four alternatives are illustrated in the matrix in Exhibit C-1. The four cells represent the following realm of possibilities:

- Alternative A, COG purchase and MCPS hauling, which depicts current MCPS fuel oil purchase and delivery practice
- Alternative B, MCPS purchase and hauling, which was used by MCPS between FY 1961 and FY 1983
- Alternative C, COG purchase and vendor hauling, which has never been tried by MCPS, but is currently used by all other school systems participating in the COG joint fuel oil procurement
- Alternative D, MCPS purchase and vendor hauling, which was used by MCPS prior to FY 1961

Each of these alternatives is discussed in greater detail in the following sections.

EXHIBIT C-1

Alternatives for the Purchase
and Delivery of Fuel Oil

	Purchase Options	
	COG	MCPS*
Delivery Options	Alternative A	Alternative B
MCPS Hauling	o Purchase with COG o MCPS Haul	o MCPS Bid Alone o MCPS Haul
	Alternative C	Alternative D
Vendor Hauling	o Purchase with COG o Vendor Haul	o MCPS Bid Alone o Vendor Haul

*Includes Montgomery County Government and Montgomery College

Alternative A: COG Purchase/MCPS Haul

Beginning in FY 1984, MCPS has participated in the jointly bid fuel oil contract with the Council of Governments. The MCPS contract specifications were first negotiated with COG representatives and later, as part of the total contract, with potential vendors. Because MCPS hauls its own fuel oil, certain modifications were necessary to ensure a reasonable contract price for the portion of oil purchased by MCPS. COG members were willing, within limits, to include MCPS requirements. But since the amount of fuel oil required by MCPS did not sufficiently increase the total COG gallons to qualify for additional price discounts, COG representatives were not willing to risk complications with potential vendors for the sake of only a single member. While participation in the COG aggregate fuel oil purchase presents advantages stemming from community cooperation, it is not known what prices would have been available to MCPS had invitations to bid been offered by MCPS alone because the data for that comparison are not available. Also, it appears likely that only fuel oil companies of a medium or larger size were able and/or willing to bid on the COG requirements. The major cost elements of Alternative A are those that result from the COG contract (purchase option) and MCPS hauling (delivery option).

Alternative B: MCPS Purchase/MCPS Haul

MCPS has had a long history of purchasing and hauling its own fuel oil (FY 1961 to FY 1983). For over 20 years, MCPS staff representing several departments, have shared the detailed responsibilities involved in the annual process of contract bidding and award and the daily activities essential to timely fuel oil delivery. Both purchase and delivery options were the responsibility of MCPS. Each year oil companies of all size categories responded to the bid specifications developed by MCPS staff; and for the past several years, the contract was awarded to the Stewart Petroleum Oil Company. For six months of the year MCPS personnel and equipment were utilized to deliver fuel oil to MCPS buildings and to Montgomery County Government and Montgomery College locations. The cost elements of this alternative result from the costs associated with the MCPS purchase option and the MCPS hauling delivery option.

Alternative C: COG Purchase and Haul

Since MCPS is the only COG member that hauls its own fuel oil, all other members receive delivery as part of the COG contract awarded to the vendor. For these municipalities and agencies, fuel oil procurement is much like any other service procurement in that there is minimal involvement in procedures and deliveries. The vendor is responsible for the performance of all tasks associated with the efficient provision of fuel oil to the designated locations. Either an automatic fill schedule, based on degree days, tank size, and building size or direct request to the vendor is used to make deliveries.

Alternative D: MCPS Purchase/Vendor Haul

Prior to the establishment of the fuel oil hauling program (FY 1961), MCPS received deliveries of fuel oil as part of the contract awarded to the vendor. This method, without any of the modifications found in the other alternatives, presents the "no frills" approach used by most consumers. There are no special purchase options and no special hauling options. The price of this alternative is the result of combining the elements of the MCPS purchase option to the vendor hauling delivery option.

Major Cost Components of the Model

The three categories of cost components evaluated by the model are (1) purchase price of the fuel oil from the vendor, which can vary twice monthly based upon an industry oil index, (2) cost of delivering fuel oil to schools, and (3) impact of the Montgomery County fuel oil tax. Some of these cost components are obtained differently for Alternatives A and C.

The COG contract quotes two separate prices, one for purchase only ("under the fill") and a second for purchase and vendor delivery. This information is sufficient for Alternative C, but requires that the model be able to calculate the MCPS cost-per-gallon to haul fuel oil from the vendor's terminal to schools for use in Alternative A.

The model uses the following cost items in calculating MCPS' total fuel oil delivery cost-per-gallon:

- Drivers' Salaries (Actual when available from past years or actual adjusted for step increases and estimated cost-of-living when projecting to other years)
- Overtime Salaries (With same adjustments noted for drivers' salaries)
- Fixed Charges (30 percent of above salaries)
- Maintenance and Operation of Vehicles (Actual when available from past years or actual adjusted for inflation when projecting to other years)
- Depreciation (Straight line based on actual from past year)

The sum of the above cost components is then divided by the annual actual or projected number of gallons of fuel oil delivered by MCPS.

The final cost factor that must be considered in the model is the Montgomery County fuel oil tax that is imposed on fuel oil delivered in the county. Tax is not paid on fuel oil which is delivered by MCPS, but is paid on fuel oil delivered by the vendor. The current level of the tax is $0.01332 per gallon for No. 2 fuel oil and $0.013896 per gallon for No. 5 oil.

Assumptions Underlying Assessment of Alternatives

A critical aspect of modeling is the consistent use of standard assumptions and methods of calculating cost components. This decision model is based on the following assumptions:

- MCPS, bidding alone, would not be able to improve upon either the purchase-only or purchase-and-deliver fuel oil prices obtained by COG.
- MCPS can not easily move annually into or out of the fuel oil hauling program, and longer-term decisions should be made.
- COG will continue to function as an agency for the joint procurement of fuel oil.
- Fuel oil for the 39 schools with small tank capacities or limited access will be purchased from and delivered by the vendor.

These assumptions should be verified periodically. For example, the first assumption has the effect of eliminating Alternatives B and D under which MCPS does its own fuel oil purchasing. In FY 1983 that was a sound assumption. In FY 1984 the volume discount was considerably smaller, and the assumption less certain. Depending on the bid-price trend over a longer period and the degree to which MCPS wants to encourage minority and small firms to bid, that assumption may need to be changed.

The last assumption was affected by the decision, beginning in FY 1985, to have MCPS haul fuel oil to 30 of the 39 school locations previously supplied by vendor delivery. The effect of this decision on the FY 1984 simulations used for this report is discussed in Chapter 2.

Layout of the Model

As shown in Exhibit C-2, the "model" is actually a matrix with the 24 price periods of the COG contract (two periods for each month) and a "total" column shown across the top of the matrix and the procurement/delivery alternatives to be priced listed down the left side. Each run of the simulation model fills in the cells of the matrix by calculating the per-period and total cost for each alternative. The following four alternatives were used in the runs shown in Exhibit C-2.

- Alternative A for actual FY 1984 data (COG purchase, MCPS delivery)
- Alternative C for actual FY 1984 data (COG purchase, vendor delivery)
- Alternative A for a given set of "what if" usage and price conditions
- Alternative C for a given set of "what if" usage and price conditions

Exhibit C-2 also displays the formulas and internal logic for the operation of this simulation model.

Exhibit C-2

FORMULAS AND LOGIC FOR SIMULATION MODEL
FUEL OIL ANALYSIS FOR FY 1984, ACTUAL AND WHAT IF CASE 3 (FO/84- 3)

NOTES: 1. ACTUAL FY 84 FUEL OIL USAGE DATA IS USED FOR PRICE PERIODS 1-16
2. ACTUAL FY 84 PRICE DATA IS USED FOR PRICE PERIODS 1-18
3. PROJECTED USAGE DATA IS USED FOR FY 84 PERIODS 17-24, BASED ON ACTUAL USAGE FOR THESE PERIODS IN FY 81-83
4. PROJECTED PRICE DATA ARE USED FOR FY 84 PRICE PERIODS 19-24, BASED ON TRENDS FOR THESE PERIODS FOR FY 83
5. PROJECTED MCPS HAULING COSTS FOR FY 84 OF $98,738/USAGE ARE USED
6. ASSUMES MONTHLY USAGE EVENLY SPLIT BETWEEN THE TWO PRICE PERIODS

ASSUMPTIONS/WHAT IF CONDITIONS:
1. USAGE INCREASED 5% OVER FY 84 FOR DEC-MARCH
2. COST PER GALLON SAME AS FY 84

	JULY		AUGUST		SEPT	
	PRICE PERIOD 1	PRICE PERIOD 2	PRICE PERIOD 3	PRICE PERIOD 4	PRICE PERIOD 5	PRICE PERIOD 6
ACTUAL FY 84 ALTERNATIVE C						
COG PURCHASE AND DELIVERY						
COG COST OF NO. 2 DELIVERED FY 84	B48+.0074	C48+.0074	D48+.0074	E48+.0074	F48+.0074	G48+.0074
COG COST OF NO. 5 DELIVERED FY 84	B49+.0076	C49+.0076	D49+.0076	E49+.0076	F49+.0076	G49+.0076
USAGE OF NO.2 FUEL OIL FY 84	6300	6300	6300	6300	9450	9450
USAGE OF NO. 5 FUEL OIL FY 84	9450	9450	18900	18900	28350	28350
MC CO TAX FY 84	(B28*.01332	(C28*.01332	(D28*.01332	(E28*.01332	(F28*.01332	(G28*.01332
COST OF ALTERNATIVE C ACTUAL FY 84	B26*B28+B27	C26*C28+C27	D26*D28+D27	E26*E28+E27	F26*F28+F27	G26*G28+G27
WHAT IF FY 84 ALTERNATIVE C						
FOR ABOVE CONDITIONS/ASSUMPTIONS						
COG COST OF NO. 2 DELIVERED	B57+.0074	C57+.0074	D57+.0074	E57+.0074	F57+.0074	G57+.0074
COG COST OF NO. 5 DELIVERED	B58+.0076	C58+.0076	D58+.0076	E58+.0076	F58+.0076	G58+.0076
USAGE OF NO. 2 FUEL OIL	L39	C28	D28	E28	F28	G28
USAGE OF NO. 5 FUEL OIL	B29	C29	D29	E29	F29	G29
MC CO TAX	B39*.01332+	C39*.01332+	D39*.01332+	E39*.01332+	F39*.01332+	G39*.01332+
COST OF ALTERNATIVE C WHAT IF	B37*B39+B38	C37*C39+C38	D37*D39+D38	E37*E39+E38	F37*F39+F38	G37*G39+G38
ACTUAL FY 84 ALTERNATIVE A						
COG PURCHASE AND MCPS DELIVERY						
COG COST NO. 2 UNDER FILL FY 84	.81255	.8128	.83300	.8425	.85325	.85575
COG COST NO. 5 UNDER FILL FY 84	.72906	.73747	.75985	.77109	.77467	.77542
MCPS DELIVERY COST FY 84	(B28+B29)*(	(C28+C29)*(	(D28+D29)*(	(E28+E29)*(	(F28+F29)*(	(G28+G29)*(
COST OF ALTERNATIVE A ACTUAL FY 84	B48*B28+B49	C48*C28+C49	D48*D28+D49	E48*E28+E49	F48*F28+F49	G48*G28+G49
WHAT IF FY 84 ALTERNATIVE A						
FOR ABOVE CONDITIONS/ASSUMPTIONS						
COG COST NO. 2 UNDER FILL	B48	C48	D48	E48	F48	G48
COG COST NO. 5 UNDER FILL	B49	C49	D49	E49	F49	G49
MCPS DELIVERY COST	(B39+B40)*(	(C39+C40)*(	(D39+D40)*(	(E39+E40)*(	(F39+F40)*(	(G39+G40)*(
COST OF ALTERNATIVE A WHAT IF	B57*B39+B58	C57*C39+C58	D57*D39+D58	E57*E39+E58	F57*F39+F58	G57*G39+G58

Exhibit C-2 (continued)

	H	I	J	K	L	M	N	O	P	Q
19	OCT		NOV		DEC		JAN		FEB	
20	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD	PRICE PERIOD
21	7	8	9	10	11	12	13	14	15	16
26	H48+.0074	I48+.0074	J48+.0074	K48+.0074	L48+.0074	M48+.0074	N48+.0074	O48+.0074	P48+.0074	Q48+.0074
27	H49+.0076	I49+.0076	J49+.0076	K49+.0076	L49+.0076	M49+.0076	N49+.0076	O49+.0076	P49+.0076	Q49+.0076
28	3150	3150	12600	12600	100800	100800	198500	198500	88116	88116
29	9450	9450	47250	47250	245700	245700	473844	473844	160655	160655
30	(H28*.01332	(I28*.01332	(J28*.01332	(K28*.01332	(L28*.01332	(M28*.01332	(N28*.01332	(O28*.01332	(P28*.01332	(Q28*.01332
32	H26*H28+H27	I26*I28+I27	J26*J28+J27	K26*K28+K27	L26*L28+L27	M26*M28+M27	N26*N28+N27	O26*O28+O27	P26*P28+P27	Q26*Q28+Q27
36										
37	H57+.0074	I57+.0074	J57+.0074	K57+.0074	L57+.0074	M57+.0074	N57+.0074	O57+.0074	P57+.0074	Q57+.0074
38	H58+.0076	I58+.0076	J58+.0076	K58+.0076	L58+.0076	M58+.0076	N58+.0076	O58+.0076	P58+.0076	Q58+.0076
39	H28	I28	J28	K28	L28*1.05	M28*1.05	N28*1.05	O28*1.05	P28*1.05	Q28*1.05
40	H29	I29	J29	K29	L29*1.05	M29*1.05	N29*1.05	O29*1.05	P29*1.05	Q29*1.05
41	H39*.01332+	I39*.01332+	J39*.01332+	K39*.01332+	L39*.01332+	M39*.01332+	N39*.01332+	O39*.01332+	P39*.01332+	Q39*.01332+
43	H37*H39+H38	I37*I39+I38	J37*J39+J38	K37*K39+K38	L37*L39+L38	M37*M39+M38	N37*N39+N38	O37*O39+O38	P37*P39+P38	Q37*Q39+Q38
47										
48	.8465	.83	.81875	.81625	.81875	.808	.84275	.8575	.98975	.965
49	.77257	.76354	.74932	.75482	.76182	.75443	.779439	.793447	.84854	.845281
50	(H28+H29)*(	(I28+I29)*(	(J28+J29)*(	(K28+K29)*(	(L28+L29)*(	(M28+M29)*(	(N28+N29)*(	(O28+O29)*(	(P28+P29)*(	(Q28+Q29)*(
52	H48*H28+H49	I48*I28+I49	J48*J28+J49	K48*K28+K49	L48*L28+L49	M48*M28+M49	N48*N28+N49	O48*O28+O49	P48*P28+P49	Q48*Q28+Q49
56										
57	H48	I48	J48	K48	L48	M48	N48	O48	P48	Q48
58	H49	I49	J49	K49	L49	M49	N49	O49	P49	Q49
59	(H39+H40)*(	(I39+I40)*(	(J39+J40)*(	(K39+K40)*(	(L39+L40)*(	(M39+M40)*(	(N39+N40)*(	(O39+O40)*(	(P39+P40)*(	(Q39+Q40)*(
61	H57*H39+H58	I57*I39+I58	J57*J39+J58	K57*K39+K58	L57*L39+L58	M57*M39+M58	N57*N39+N58	O57*O39+O58	P57*P39+P58	Q57*Q39+Q58

Exhibit C-2 (continued)

	R	S	T	U	V	W	X	Y	Z	AA	AB
	MARCH		APRIL		MAY		JUNE				
	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE			
	PERIOD	PERIOD	PERIOD	PERIOD	PERIOD	PERIOD	PERIOD	PERIOD	TOTAL		
	17	18	19	20	21	22	23	24			
										ACTUAL FY 84 ALT C	
										COG PURCH &DELIVER	
	R48+.0074	S48+.0074	T48+.0074	U48+.0074	V48+.0074	W48+.0074	X48+.0074	Y48+.0074		COG COST # 2 DEL 84	
	R49+.0076	S49+.0076	T49+.0076	U49+.0076	V49+.0076	W49+.0076	X49+.0076	Y49+.0076		COG COST # 5 DEL 84	
	6300	85213	56080	56080	3642	3642	0	0	SUM(B28:Y28	USAGE # 2 FY 84	
	213120	213120	188411	188411	61774	61774	0	0	SUM(B29:Y29	USAGE # 5 FY 84	
	(R28*.01332	(S28*.01332	(T28*.01332	(U28*.01332	(V28*.01332	(W28*.01332	(X28*.01332	(Y28*.01332	SUM(B30:Y30	MC CO TAX FY 84	
	R26*R28+R27	S26*S28+S27	T26*T28+T27	U26*U28+U27	V26*V28+V27	W26*W28+W27	X26*X28+X27	Y26*Y28+Y27	SUM(B32:Y32	COST ALT C ACTUAL 84	
										WHAT IF FY 84 ALT C	
										FOR ABOVE CONDITIONS	/ASSUMPTIONS
	R57+.0074	S57+.0074	T57+.0074	U57+.0074	V57+.0074	W57+.0074	X57+.0074	Y57+.0074		COG COST # 2 DELIVER	
	R58+.0076	S58+.0076	T58+.0076	U58+.0076	V58+.0076	W58+.0076	X58+.0076	Y58+.0076		COG COST # 5 DELIVER	
	R28*1.05	S28*1.05	T28	U28	V28	W28	X28	Y28	SUM(B39:Y39	USAGE # 2 FUEL OIL	
	R29*1.05	S29*1.05	T29	U29	V29	W29	X29	Y29	SUM(B40:Y40	USAGE # 5 FUEL OIL	
	R39*.01332+	S39*.01332+	T39*.01332+	U39*.01332+	V39*.01332+	W39*.01332+	X39*.01332+	Y39*.01332+	SUM(B41:Y41	MC CO TAX	
	R37*R39+R38	S37*S39+S38	T37*T39+T38	U37*U39+U38	V37*V39+V38	W37*W39+W38	X37*X39+X38	Y37*Y39+Y38	SUM(B43:Y43	COST ALT C WHAT IF	
										ACTUAL FY 84 ALT A	
										COG PURCH MCPS DELIVERY	
	.85625	.81400	.79	.785	.82	.83	.815	.815		COG # 2 UND FILL 84	
	.78582	.76665	.75	.74	.77	.78	.76	.76		COG # 5 UND FILL 84	
	(R28+R29)*(	(S28+S29)*(	(T28+T29)*(	(U28+U29)*(	(V28+V29)*(	(W28+W29)*(	(X28+X29)*(	(Y28+Y29)*(	SUM(B50:Y50	MCPS DEL COST FY 84	
	R48*R28+R49	S48*S28+S49	T48*T28+T49	U48*U28+U49	V48*V28+V49	W48*W28+W49	X48*X28+X49	Y48*Y28+Y49	SUM(B52:Y52	COST ALT A ACTUAL 84	
										WHAT IF FY 84 ALT A	
										FOR ABOVE CONDITIONS	/ASSUMPTIONS
	R48	S48	T48	U48	V48	W48	X48	Y48		COG COST #2 UND FILL	
	R49	S49	T49	U49	V49	W49	X49	Y49		COG COST #5 UND FILL	
	(R39+R40)*(	(S39+S40)*(	(T39+T40)*(	(U39+U40)*(	(V39+V40)*(	(W39+W40)*(	(X39+X40)*(	(Y39+Y40)*(	SUM(B59:Y59	MCPS DELIVERY COST	
	R57*R39+R58	S57*S39+S58	T57*T39+T58	U57*U39+U58	V57*V39+V58	W57*W39+W58	X57*X39+X58	Y57*Y39+Y58	SUM(B61:Y61	COST ALT A WHAT IF	

APPENDIX D

A Model for Monitoring Current Fiscal Year Usage, Price, and Expenditure for Fuel Oil

Although similar in construction to the procurement/delivery model, the purpose of the usage/price/expenditure model is to assist the Energy Management Unit in the Division of Construction and Capital Projects to: (1) monitor the "fiscal year-to-date" usage, price, and dollar expenditures for fuel oil; (2) project these same data through the end of the current fiscal year under various assumptions about operating and weather conditions; (3) assist the preparation of the fuel oil portion of the operating budget for the following fiscal year; and (4) respond to Board and managers' requests for financial data and "What if?" situations.

Description of the Model

The model assumes that MCPS is purchasing fuel oil under the COG joint fuel oil procurement. However, as the primary purpose of the model is to monitor usage, fuel oil purchase price, and expenditures, the model does not involve fuel oil hauling costs and is usable with either Alternative A or C. The model assumes that a decision concerning the procurement and delivery methods has already been made.

As shown in Exhibit D-1, the 24 price periods of the COG contract and a total column are across the top of the simulation matrix. Down the left side of the matrix are specific data elements for both categories of fuel oil, No. 2 and No. 5.

For each category of fuel oil and price period, the model identifies, as appropriate, the following elements:

- Projected usage (beginning of year projection)
- Actual usage
- Projected vs. actual usage

- Projected price (beginning of year)
- Actual price
- Projected price vs. actual price

- Projected expenditures (beginning of year)
- Actual expenditures (to date)
- Projected vs. actual expenditures

- Updated projection of usage (for remainder of year)
- Updated projection of price (for remainder of year)
- Updated projection of expenditures

Exhibit D-1

	A	B	C
1		A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL	
2		USAGE, PRICE, AND EXPENDITURES	
3			
4			
5			
6	SENIARO RUN		
7			
8	ACTUAL DATA TO DATE FOR PERIODS 1-12		
9			
10	ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24		
11			
12			
13			
14			
15			
16			
17			
18			JULY
19		PRICE	PRICE
20		PERIOD	PERIOD
21		1	2
22			
23	PROJECTION FOR END OF PRICE PERIOD 12		
24			
25	NO. 2 FUEL OIL		
26			
27	PROJECTED USAGE (BEGINNING OF YEAR)	.005*227	.005*227
28	ACTUAL USAGE	9450	9450
29	PROJECTED VS. ACTUAL USAGE	IF(B28=0,0,B27-B28)	IF(C28=0,0,C27-C28)
30			
31	PROJECTED PRICE (BEGINNING OF YEAR)	.82	.83
32	ACTUAL PRICE	.81255	.81280
33	PROJECTED VS. ACTUAL PRICE	IF(B32=0,0,B31-B32)	IF(C32=0,0,C31-C32)
34			
35	PROJECTED EXPENDITURES	B27*B31	C27*C31
36	ACTUAL EXPENDITURES	B28*B32	C28*C32
37	PROJECTED VS. ACTUAL EXPENDITURES	IF(B36=0,0,B35-B36)	IF(C36=0,0,C35-C36)
38			
39	UPDATED PROJECTION OF USAGE	IF(B28 <>0,B28,B27)	IF(C28<>0,C28,C27)
40	UPDATED PROJECTION OF PRICE	IF(B32<>0,0,B31)	IF(C32<>0,0,C31)
41	UPDATED PROJECTION OF EXPENDITURE	IF(B36<>0,B36,B39*B40)	IF(C36<>0,C36,C39*C40)
42			
43	NO. 5 FUEL OIL		
44			
45	PROJECTED USAGE (BEGINNING OF YEAR)	.0025*245	.0025*245
46	ACTUAL USAGE	15750	15750
47	PROJECTED VS. ACTUAL USAGE	IF(B46=0,0,B45-B46)	IF(C46=0,0,C45-C46)
48			
49	PROJECTED PRICE (BEGINNING OF YEAR)	.74	.74
50	ACTUAL PRICE	.72706	.73747
51	PROJECTED VS. ACTUAL PRICE	IF(B50=0,0,B49-B50)	IF(C50=0,0,C49-C50)
52			
53	PROJECTED EXPENDITURES	B45*B49	C45*C49
54	ACTUAL EXPENDITURES	IF(B46<>0,B46*B50,0)	IF(C46<>0,C46*C50,0)
55	PROJECTED VS. ACTUAL EXPENDITURES	IF(B54=0,0,B53-B54)	IF(C54=0,0,C53-C54)
56			
57	UPDATED PROJECTION OF USAGE	IF(B46<>0,B46,B45)	IF(C46<>0,C46,C45)
58	UPDATED PROJECTION OF PRICE	IF(B50<>0,0,B49)	IF(C50<>0,0,C49)
59	UPDATED PROJECTION OF EXPENDITURE	IF(B46<>0,B46*B50,B57*B58)	IF(C46<>0,C46*C50,C57*C58)
60			

Exhibit D-1 (Continued)

	D	E	F	G
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18		AUGUST		SEPT
19	PRICE	PRICE	PRICE	PRICE
20	PERIOD	PERIOD	PERIOD	PERIOD
21	3	4	5	6
22				
23				
24				
25				
26				
27	.0035*227	.0035*227	.007*227	.007*227
28	3150	3150	9450	9450
29	IF(D28=0,0,D27-D28)	IF(E28=0,0,E27-E28)	IF(F28=0,0,F27-F28)	IF(G28=0,0,G27-G28)
30				
31	.83	.86	.86	.86
32	.833	.846825	.95325	.859575
33	IF(D32=0,0,D31-D32)	IF(E32=0,0,E31-E32)	IF(F32=0,0,F31-F32)	IF(G32=0,0,G31-G32)
34				
35	D27*D31	E27*E31	F27*F31	G27*G31
36	D28*D32	E28*E32	F28*F32	G28*G32
37	IF(D36=0,0,D35-D36)	IF(E36=0,0,E35-E36)	IF(F36=0,0,F35-F36)	IF(G36=0,0,G35-G36)
38				
39	IF(D28<>0,D28,D27)	IF(E28<>0,E28,E27)	IF(F28<>0,F28,F27)	IF(G28<>0,G28,G27)
40	IF(D32<>0,0,D31)	IF(E32<>0,0,E31)	IF(F32<>0,0,F31)	IF(G32<>0,0,G31
41	IF(D36<>0,D36,D39*D40)	IF(E36<>0,E36,E39*E40)	IF(F36<>0,F36,F39*F40)	IF(G36<>0,G36,G39*G40)
42				
43				
44				
45	.0055*245	.0055*245	.0065*245	.0065*245
46	22050	22050	22050	22050
47	IF(D46=0,0,D45-D46)	IF(E46=0,0,E45-E46)	IF(F46=0,0,F45-F46)	IF(G46=0,0,G45-G46)
48				
49	.77	.78	.8	.81
50	.75935	.77169	.77467	.77542
51	IF(D50=0,0,D49-D50)	IF(E50=0,0,E49-E50)	IF(F50=0,0,F49-F50)	IF(G50=0,0,G49-G50)
52				
53	D45*D49	E45*E49	F45*F49	G45*G49
54	IF(D46<>0,D46*D50,0)	IF(E46<>0,E46*E50,0)	IF(F46<>0,F46*F50,0)	IF(G46<>0,G46*G50,0)
55	IF(D54=0,0,D53-D54)	IF(E54=0,0,E53-E54)	IF(F54=0,0,F53-F54)	IF(G54=0,0,G53-G54)
56				
57	IF(D46<>0,D46,D45)	IF(E46<>0,E46,E45)	IF(F46<>0,F46,F45)	IF(G46<>0,G46,G45)
58	IF(D50<>0,0,D49)	IF(E50<>0,0,E49)	IF(F50<>0,0,F49)	IF(G50<>0,0,G49)
59	IF(D46<>0,D46*D50,D57*D58)	IF(E46<>0,E46*E50,E57*E58)	IF(F46<>0,F46*F50,F57*F58)	IF(G46<>0,G46*G50,G57*G58)
60				

Exhibit D-1 (continued)

	H	I	J	K
1				
2				
3				
4				
5				
6	SENIARO RUN			
7				
8	ACTUAL DATA TO DATE FOR PERIODS 1-12			
9				
10	ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24			
11				
12				
13				
14				
15				
16				
17				
18		OCT		NOV
19	PRICE	PRICE	PRICE	PRICE
20	PERIOD	PERIOD	PERIOD	PERIOD
21	7	8	9	10
22				
23				
24				
25				
26				
27	.0055*Z27	.0055*Z27	.023*Z27	.023*Z27
28	3150	3150	25200	25200
29	IF(H28=0,0,H27-H28)	IF(I28=0,0,I27-I28)	IF(J28=0,0,J27-J28)	IF(K28=0,0,K27-K28)
30				
31	.84	.84	.82	.82
32	.84e25	.8300	.81875	.81e25
33	IF(H32=0,0,H31-H32)	IF(I32=0,0,I31-I32)	IF(J32=0,0,J31-J32)	IF(K32=0,0,K31-K32)
34				
35	H27*H31	I27*I31	J27*J31	K27*K31
36	H28*H32	I28*I32	J28*J32	K28*K32
37	IF(H3e=0,0,H35-H3e)	IF(I3e=0,0,I35-I3e)	IF(J3e=0,0,J35-J3e)	IF(K3e=0,0,K35-K3e)
38				
39	IF(H28<>0,H28,H27)	IF(I28<>0,I28,I27)	IF(J28<>0,J28,J27)	IF(K28<>0,K28,K27)
40	IF(H32<>0,0,H31)	IF(I32<>0,0,I31)	IF(J32<>0,0,J31)	IF(K32<>0,0,K31)
41	IF(H3e<>0,H3e,H39*H40)	IF(I3e<>0,I3e,I39*I40)	IF(J3e<>0,J3e,J39*J40)	IF(K3e<>0,K3e,K39*K40)
42				
43				
44				
45	.0055*Z45	.0055*Z45	.024*Z45	.024*Z45
46	1e325	1e325	37800	37800
47	IF(H4e=0,0,H45-H4e)	IF(I4e=0,0,I45-I4e)	IF(J4e=0,0,J45-J4e)	IF(K4e=0,0,K45-K4e)
48				
49	.81	.80	.80	.78
50	.77257	.7e354	.74932	.75482
51	IF(H50=0,0,H49-H50)	IF(I50=0,0,I49-I50)	IF(J50=0,0,J49-J50)	IF(K50=0,0,K49-K50)
52				
53	H45*H49	I45*I49	J45*J49	K45*K49
54	IF(H4e<>0,H4e*H50,0)	IF(I4e<>0,I4e*I50,0)	IF(J4e<>0,J4e*J50,0)	IF(K4e<>0,K4e*K50,0)
55	IF(H54=0,0,H53-H54)	IF(I54=0,0,I53-I54)	IF(J54=0,0,J53-J54)	IF(K54=0,0,K53-K54)
56				
57	IF(H4e<>0,H4e,H45)	IF(I4e<>0,I4e,I45)	IF(J4e<>0,J4e,J45)	IF(K4e<>0,K4e,K45)
58	IF(H50<>0,0,H49)	IF(I50<>0,0,I49)	IF(J50<>0,0,J49)	IF(K50<>0,0,K49)
59	IF(H4e<>0,H4e*H50,H57*H58)	IF(I4e<>0,I4e*I50,I57*I58)	IF(J4e<>0,J4e*J50,J57*J58)	IF(K4e<>0,K4e*K50,K57*K58)
60				

Exhibit D-1 (continued)

```
   :          L          ::          M          ::          N          ::          O          :
 1:A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL
 2:        USAGE, PRICE, AND EXPENDITURES
 3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
16:
17:
18:                        DEC                                          JAN
19:PRICE                     PRICE                    PRICE               PRICE
20:PERIOD                    PERIOD                   PERIOD              PERIOD
21: 11                       12                       13                  14
22:-------------------------------------------------------------------------------------------------
23:
24:-------------------------------------------------------------------------------------------------
25:
26:-------------------------------------------------------------------------------------------------
27: .081*227                 .081*227                 .116*227            .011e*227
28: 91350                    91350
29: IF(L28=0,0,L27-L28)      IF(M28=0,0,M27-M28)      IF(N28=0,0,N27-N28)  IF(028=0,0,027-028)
30:
31: .83                      .83                      .85                 .85
32: .81875                   .808
33: IF(L32=0,0,L31-L32)      IF(M32=0,0,M31-M32)      IF(N32=0,0,N31-N32)  IF(032=0,0,031-032)
34:
35: L27*L31                  M27*M31                  N27*N31             027*031
36: L28*L32                  M28*M32                  N28*N32             028*032
37: IF(L36=0,0,L35-L36)      IF(M36=0,0,M35-M36)      IF(N36=0,0,N35-N36)  IF(036=0,0,035-036)
38:
39: IF(L28<>0,L28,L27)       IF(M28<>0,M28,M27)       IF(N28<>0,N28,N27)  IF(028<>0,028,027)
40: IF(L32<>0,0,L31)         IF(M32<>0,0,M31)         IF(N32<>0,0,N31)    IF(032<>0,0,031)
41: IF(L36<>0,L36,L39*L40)   IF(M36<>0,M36,M39*M40)   IF(N36<>0,N36,N39*N40)  IF(036<>0,036,039*040)
42:-------------------------------------------------------------------------------------------------
43:
44:-------------------------------------------------------------------------------------------------
45: .0865*245                .0865*245                .124*245            .124*245
46: 242550                   242550
47: IF(L46=0,0,L45-L46)      IF(M46=0,0,M45-M46)      IF(N46=0,0,N45-N46)  IF(046=0,0,045-046)
48:
49: .78                      .78                      .77                 .79
50: .78162                   .75443
51: IF(L50=0,0,L49-L50)      IF(M50=0,0,M49-M50)      IF(N50=0,0,N49-N50)  IF(050=0,0,049-050)
52:
53: L45*L49                  M45*M49                  N45*N49             045*049
54: IF(L46<>0,L46*L50,0)     IF(M46<>0,M46*M50,0)     IF(N46<>0,N46*N50,0)  IF(046<>0,046*050,0)
55: IF(L54=0,0,L53-L54)      IF(M54=0,0,M53-M54)      IF(N54=0,0,N53-N54)  IF(054=0,0,053-054)
56:
57: IF(L46<>0,L46,L45)       IF(M46<>0,M46,M45)       IF(N46<>0,N46,N45)  IF(046<>0,046,045)
58: IF(L50<>0,0,L49)         IF(M50<>0,0,M49)         IF(N50<>0,0,N49)    IF(050<>0,0,049)
59: IF(L46<>0,L46*L50,L57*L58)  IF(M46<>0,M46*M50,M57*M58)  IF(N46<>0,N46*N50,N57*N58)  IF(046<>0,046*050,057*058)
60:-------------------------------------------------------------------------------------------------
```

Exhibit D-1 (continued)

SENIARO RUN

ACTUAL DATA TO DATE FOR PERIODS 1-12

ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24

	P	Q	R	S
1:				
2:				
3:				
4:				
5:				
6:				
7:				
8:				
9:				
10:				
11:				
12:				
13:				
14:				
15:				
16:				
17:				
18:		FEB		MARCH
19:	PRICE	PRICE	PRICE	PRICE
20:	PERIOD	PERIOD	PERIOD	PERIOD
21:	15	16	17	18
22:				
23:				
24:				
25:				
26:				
27:	.0935*Z27	.0935*Z27	.066*Z27	.066*Z27
28:				
29:	IF(P28=0,0,P27-P28)	IF(Q28=0,0,Q27-Q28)	IF(R28=0,0,R27-R28)	IF(S28=0,0,S27-S28)
30:				
31:	.94	.88	.84	.8
32:				
33:	IF(P32=0,0,P31-P32)	IF(Q32=0,0,Q31-Q32)	IF(R32=0,0,R31-R32)	IF(S32=0,0,S31-S32)
34:				
35:	P27*P31	Q27*Q31	R27*R31	S27*S31
36:	P28*P32	Q28*Q32	R28*R32	S28*S32
37:	IF(P36=0,0,P35-P36)	IF(Q36=0,0,Q35-Q36)	IF(R36=0,0,R35-R36)	IF(S36=0,0,S35-S36)
38:				
39:	IF(P28<>0,P28,P27)	IF(Q28<>0,Q28,Q27)	IF(R28<>0,R28,R27)	IF(S28<>0,S28,S27)
40:	IF(P32<>0,0,P31)	IF(Q32<>0,0,Q31)	IF(R32<>0,0,R31)	IF(S32<>0,0,S31)
41:	IF(P36<>0,P36,P39*P40)	IF(Q36<>0,Q36,Q39*Q40)	IF(R36<>0,R36,R39*R40)	IF(S36<>0,S36,S39*S40)
42:				
43:				
44:				
45:	.096*Z45	.096*Z45	.079*Z45	.079*Z45
46:				
47:	IF(P46=0,0,P45-P46)	IF(Q46=0,0,Q45-Q46)	IF(R46=0,0,R45-R46)	IF(S46=0,0,S45-S46)
48:				
49:	.83	.84	.8	.76
50:				
51:	IF(P50=0,0,P49-P50)	IF(Q50=0,0,Q49-Q50)	IF(R50=0,0,R49-R50)	IF(S50=0,0,S49-S50)
52:				
53:	P45*P49	Q45*Q49	R45*R49	S45*S49
54:	IF(P46<>0,P46*P50,0)	IF(Q46<>0,Q46*Q50,0)	IF(R46<>0,R46*R50,0)	IF(S46<>0,S46*S50,0)
55:	IF(P54=0,0,P53-P54)	IF(Q54=0,0,Q53-Q54)	IF(R54=0,0,R53-R54)	IF(S54=0,0,S53-S54)
56:				
57:	IF(P46<>0,P46,P45)	IF(Q46<>0,Q46,Q45)	IF(R46<>0,R46,R45)	IF(S46<>0,S46,S45)
58:	IF(P50<>0,0,P49)	IF(Q50<>0,0,Q49)	IF(R50<>0,0,R49)	IF(S50<>0,0,S49)
59:	IF(P46<>0,P46*P50,P57*P58)	IF(Q46<>0,Q46*Q50,Q57*Q58)	IF(R46<>0,R46*R50,R57*R58)	IF(S46<>0,S46*S50,S57*S58)
60:				

Exhibit D-1 (continued)

A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL USAGE, PRICE, AND EXPENDITURES

	APRIL	MAY		
PRICE PERIOD	PRICE PERIOD 20	PRICE PERIOD 21	PRICE PERIOD 22	
19				
.0585*Z27	.0585*Z27	.0385*Z27	.0385*Z27	
IF(T28=0,0,T27-T28)	IF(U28=0,0,U27-U28)	IF(V28=0,0,V27-V28)	IF(W28=0,0,W27-W28)	
.8	.82	.82	.8	
IF(T32=0,0,T31-T32)	IF(U32=0,0,U31-U32)	IF(V32=0,0,V31-V32)	IF(W32=0,0,W31-W32)	
T27*T31	U27*U31	V27*V31	W27*W31	
T28*T32	U28*U32	V28*V32	W28*W32	
IF(T36=0,0,T35-T36)	IF(U36=0,0,U35-U36)	IF(V36=0,0,V35-V36)	IF(W36=0,0,W35-W36)	
IF(T28<>0,T28,T27)	IF(U28<>0,U28,U27)	IF(V28<>0,V28,V27)	IF(W28<>0,W28,U27)	
IF(T32<>0,0,T31)	IF(U32<>0,0,U31)	IF(V32<>0,0,V31)	IF(W32<>0,0,W31)	
IF(T36<>0,T36,T39*T40)	IF(U36<>0,U36,U39*U40)	IF(V36<>0,V36,V39*V40)	IF(W36<>0,W36,W39*W40)	
.061*Z45	.061*Z45	.020*Z45	.020*Z45	
IF(T46=0,0,T45-T46)	IF(U46=0,0,U45-U46)	IF(V46=0,0,V45-V46)	IF(W46=0,0,W45-W46)	
.74	.72	.72	.72	
IF(T50=0,0,T49-T50)	IF(U50=0,0,U49-U50)	IF(V50=0,0,V49-V50)	IF(W50=0,0,W49-W50)	
T45*T49	U45*U49	V45*V49	W45*W49	
IF(T46<>0,T46*T50,0)	IF(U46<>0,U46*U50,0)	IF(V46<>0,V46*V50,0)	IF(W46<>0,W46*W50,0)	
IF(T54=0,0,T53-T54)	IF(U54=0,0,U53-U54)	IF(V54=0,0,V53-V54)	IF(W54=0,0,W53-W54)	
IF(T46<>0,T46,T45)	IF(U46<>0,U46,U45)	IF(V46<>0,V46,V45)	IF(W46<>0,W46,W45)	
IF(T50<>0,0,T49)	IF(U50<>0,0,U49)	IF(V50<>0,0,V49)	IF(W50<>0,0,W49)	
IF(T46<>0,T46*T50,T57*T58)	IF(U46<>0,U46*U50,U57*U58)	IF(V46<>0,V46*V50,V57*V58)	IF(W46<>0,W46*W50,W57*W58)	

Exhibit D-1 (continued)

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18		JUNE		
19	PRICE	PRICE		
20	PERIOD	PERIOD		
21	23	24	TOTAL	
22				
23				
24				PROJECTION FOR END OF PRICE PERIOD 12
25				
26				NO. 2 FUEL OIL
27	.0025*Z27	.0025*Z27		
28			12823.9	PROJECTED USAGE (BEGINNING OF (EAR)
29	IF(X28=0,0,X27-X28)	IF(Y28=0,0,Y27-Y28)	SUM(B28:Y28)	ACTUAL USAGE (TO DATE)
30				PROJECTED VS. ACTUAL USAGE (TO DATE
31	.8	.8		
32				PROJECTED PRICE (BEGINNING OF (EAR)
33	IF(X32=0,0,X31-X32)	IF(Y32=0,0,Y31-Y32)		ACTUAL PRICE
34				PROJECTED VS. ACTUAL PRICE
35	X27*X31	Y27*Y31	SUM(B35:Y35)	
36	X28*X32	Y28*Y32	SUM(B36:Y36)	PROJECTED EXPENDITURES
37	IF(X36=0,0,X35-X36)	IF(Y36=0,0,Y35-Y36)		ACTUAL EXPENDITURES (TO DATE)
38				PROJECTED VS. ACTUAL EXPENDITURES
39	IF(X28<>0,X28,X27)	IF(Y28<>0,Y28,Y27)	SUM(B39:Y39)	
40	IF(X32<>0,0,X31)	IF(Y32<>0,0,Y31)		UPDATED PROJECTION OF USAGE
41	IF(X36<>0,X36,X39*X40)	IF(Y36<>0,Y36,Y39*Y40)	SUM(B41:Y41)	UPDATED PROJECTION OF PRICE
42				UPDATED PROJECTION OF EXPENDITURE
43				
44				NO. 5 FUEL OIL
45	0	0		
46			2722.30	PROJECTED USAGE (BEGINNING OF (EAR)
47	IF(X46=0,0,X45-X46)	IF(Y46=0,0,Y45-Y46)	SUM(B46:Y46)	ACTUAL USAGE (TO DATE)
48				PROJECTED VS. ACTUAL USAGE (TO DATE)
49	.72	.72		
50				PROJECTED PRICE (BEGINNING OF (EAR)
51	IF(X50=0,0,X49-X50)	IF(Y50=0,0,Y49-Y50)		ACTUAL PRICE
52				PROJECTED VS. ACTUAL PRICE
53	X45*X49	Y45*Y49	SUM(B53:Y53)	
54	IF(X46<>0,X46*X50,0)	IF(Y46<>0,Y46*Y50,0)	SUM(B54:Y54)	PROJECTED EXPENDITURES
55	IF(X54=0,0,X53-X54)	IF(Y54=0,0,Y53-Y54)		ACTUAL EXPENDITURES (TO DATE)
56				PROJECTED VS. ACTUAL EXPENDITURES
57	IF(X46<>0,X46,X45)	IF(Y46<>0,Y46,Y45)	SUM(B57:Y57)	
58	IF(X50<>0,0,X49)	IF(Y50<>0,0,Y49)		UPDATED PROJECTION OF USAGE
59	IF(X46<>0,X46*X50,X57*X58)	IF(Y46<>0,Y46*Y50,Y57*Y58)	SUM(B59:Y59)	UPDATED PROJECTION OF PRICE
60				UPDATED PROJECTION OF EXPENDITURE

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The model's detailed logic and calculations can be examined on Exhibit D-1.

In actual use by the managers the model would be updated with the most recent usage and purchase price data at the end of each price period (twice each month) and re-run to provide updated end-of-year projections. As MCPS does not currently collect usage data by price period, the monthly usage data is assumed to be equally divided between the two price periods contained in each month. When run at the end of any given price period, the simulation model will report actual per period expenditures for the year to date, project the remaining price period expenditures, and report projected total expenditures for the current fiscal year.

In fact, the model could and should be run several times at the end of each price period (or monthly) to determine what effect on total end-of-year expenditures certain "what if" conditions of usage and price would have. For example, if there is a warm trend forecast for the second half of the heating season, what will be the projected total expenditures for fuel oil if usage is decreased 5 percent from the original projection for the remaining months. Or, if fuel oil prices are in a downward trend, what will be the projected total expenditures if the price is 6 percent less then originally projected for the next three price periods but the same as projected for the remaining price periods?

To Set Up Model at Beginning of the Fiscal Year

Projected usage data can be entered into the model at the beginning of the fiscal year in one of two ways. A single total projection of No. 2 and No. 5 usage can be entered in Cells Z27 and Z47 respectively. The model will distribute the annual projected usage over the 24 price periods based on the periods' average percentage of total usage for the past three years. Or, if the user prefers, individual per period usage data may be entered into each cell.

Projected purchase price data for each price period must be individually entered for both No. 2 and No. 5 fuel oil. The model will then calculate the expenditures for each price period and the total projected expenditures for the year. By changing input data and re-running the model, the user can easily see what would happen to budget planning projections if price or usage varied either separately or in combination.

To Run the Model at the End of a Price Period

At the end of each price period, the user should substitute the actual usage and purchase price data for the projections for the preceding price period. As MCPS currently collects usage data by month rather than price period, the model may only be run once each month and must assume that usage is equally divided between the two price periods in the month. Using the newly entered actual data, the model re-calculates projected total expenditures for the remainder of the fiscal year, assuming no changes in the price/usage assumptions for the remaining periods.

However, in practice, the user should have a better feel each month for the accuracy of the original projections. The model provides the opportunity to refine the projections for the remainder of the year and produce an updated projection of usage and expenditures. The end-of-year projections should become more accurate as the year progress and a greater percentage of data is actual.

Scenario of Usage

Exhibit D-2 is an example of how the model might be used. The scenario run has been set up as if it is the end of the twelfth price period. The scenario fiscal year began with the annual projections of usage, purchase price, and expenditures as shown in Exhibit D-2. It is assumed that at the end of each price period actual data for usage and price has been added. For example, at the end of the twelfth price period, actual data of 91,350 gallons of No. 2 fuel oil were entered (Cell M28) at an actual price for that period of $.808 per gallon (Cell M31). The run calculated that the expenditures for the twelfth price period for No. 2 fuel oil was $73,811 (Cell M36).

As can be seen in the heading of the report, this run assumed no changes from the original projections for the remainder of the year. As such, the updated projection, as of the end of the twelfth price period, for the total usage of No. 2 fuel oil is 1,098,485 gallons (Cell Z39) and projected expenditures of $925,147 (Cell Z41). This compares to the original beginning-of-year projection of 1,262,369 gallons and $955,355.

The user would now want to execute several more runs of the model under various conditions of continuing usage and price to determine a best and worse case scenario for total end-of-year expenditures.

Exhibit D-2

A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL USAGE, PRICE, AND EXPENDITURES

SENIARO RUN

ACTUAL DATA TO DATE FOR PERIODS 1-12

ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24

	JULY		AUGUST		SEPT	
	PRICE PERIOD 1	PRICE PERIOD 2	PRICE PERIOD 3	PRICE PERIOD 4	PRICE PERIOD 5	PRICE PERIOD 6
PROJECTION FOR END OF PRICE PERIOD 12						
NO. 2 FUEL OIL						
PROJECTED USAGE (BEGINNING OF YEAR)	6312	6312	4418	4418	8837	8837
ACTUAL USAGE	9450	9450	3150	3150	9450	9450
PROJECTED VS. ACTUAL USAGE	-3138	-3138	1268	1268	-613	-613
PROJECTED PRICE (BEGINNING OF YEAR)	.82	.83	.83	.86	.86	.86
ACTUAL PRICE	.81255	.8128	.833	.84825	.85325	.85575
PROJECTED VS. ACTUAL PRICE	.00745	.0172	-.003	.01175	.00675	.00425
PROJECTED EXPENDITURES	5176	5239	3667	3800	7599	7599
ACTUAL EXPENDITURES	7679	7681	2624	2672	8063	8087
PROJECTED VS. ACTUAL EXPENDITURES	-2503	-2442	1043	1128	-464	-487
UPDATED PROJECTION OF USAGE	9450	9450	3150	3150	9450	9450
UPDATED PROJECTION OF PRICE	0	0	0	0	0	0
UPDATED PROJECTION OF EXPENDITURE	7679	7681	2624	2672	8063	8087
NO. 5 FUEL OIL						
PROJECTED USAGE (BEGINNING OF YEAR)	6807	6807	14974	14974	17697	17697
ACTUAL USAGE	15750	15750	22050	22050	22050	22050
PROJECTED VS. ACTUAL USAGE	-8943	-8943	-7076	-7076	-4353	-4353
PROJECTED PRICE (BEGINNING OF YEAR)	.74	.74	.77	.78	.8	.81
ACTUAL PRICE	.72906	.73747	.75985	.77109	.77867	.77542
PROJECTED VS. ACTUAL PRICE	.01094	.00253	.01015	.00891	.02133	.03458
PROJECTED EXPENDITURES	5037	5037	11530	11680	14158	14335
ACTUAL EXPENDITURES	11483	11615	16755	17003	17081	17098
PROJECTED VS. ACTUAL EXPENDITURES	-6446	-6578	-5224	-5322	-2924	-2763
UPDATED PROJECTION OF USAGE	15750	15750	22050	22050	22050	22050
UPDATED PROJECTION OF PRICE	0	0	0	0	0	0
UPDATED PROJECTION OF EXPENDITURE	11483	11615	16755	17003	17081	17098

Exhibit D-2 (continued)

A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL USAGE, PRICE, AND EXPENDITURES

SENTARO RUN

ACTUAL DATA TO DATE FOR PERIODS 1-12

ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24

	OCT		NOV		DEC		JAN		FEB	
PRICE PERIOD 7	PRICE PERIOD 8	PRICE PERIOD 9	PRICE PERIOD 10	PRICE PERIOD 11	PRICE PERIOD 12	PRICE PERIOD 13	PRICE PERIOD 14	PRICE PERIOD 15	PRICE PERIOD 16	
.943	.943	29034	29034	102252	102252	146435	14643	118032	118032	
3150	3150	25200	25200	91350	91350					
3793	3793	3834	3834	10902	10902	0	0	0	0	
.84	.84	.82	.82	.83	.83	.85	.95	.94	.88	
-.00625	.83	.81875	.81625	.81875	.808					
	.01	.00125	.00375	.01125	.022	0	0	0	0	
5832	5832	23808	23808	84869	84869	124470	13911	110950	103868	
2868	2815	20633	20570	74793	73811	0	0	0	0	
3168	3218	3176	3239	10076	11058	0	0	0	0	
3150	3150	25200	25200	91350	91350	146435	14643	118032	118032	
0	0	0	0	0	0	.85	.95	.94	.88	
2868	2815	20633	20570	74793	73811	124470	13911	110950	103868	
14974	14974	65343	65343	235507	235507	337606	337606	261372	261372	
16325	16325	37800	37800	242550	242550					
-1351	-1351	27543	27543	-7043	-7043	0	0	0	0	
.81	.8	.8	.78	.78	.78	.77	.79	.83	.84	
.77257	.78354	.74932	.75482	.78182	.75443					
.03743	.03646	.05068	.02518	.01818	.02557	0	0	0	0	
12129	11980	52274	50768	183696	183696	259957	260709	216939	219583	
12612	12465	28324	28532	184779	182987	0	0	0	0	
-483	-485	23950	22435	-1084	709	0	0	0	0	
16325	16325	37800	37800	242550	242550	337606	337606	261372	261372	
0	0	0	0	-0	0	.77	.79	.83	.84	
12612	12465	28324	28532	184779	182987	259957	260709	216939	219583	

Exhibit D-2 (continued)

A MODEL TO MONITOR CURRENT FISCAL YEAR FUEL OIL
USAGE, PRICE, AND EXPENDITURES

SEVERN F.H.

ACTUAL DATA TO DATE FOR PERIODS 1-12

ORIGINAL PROJECTIONS NOT CHANGED FOR PERIODS 13-24

MARCH		APRIL		MAY		JUNE			
PRICE PERIOD 17	PRICE PERIOD 18	PRICE PERIOD 19	PRICE PERIOD 20	PRICE PERIOD 21	PRICE PERIOD 22	PRICE PERIOD 23	PRICE PERIOD 24	TOTAL	
									PROJECTION FOR END OF PRICE PERIOD 12
									NO. 2 FUEL OIL
83316	83316	73849	73849	48601	48601	3156	3156	1262369	PROJECTED USAGE (BEGINNING OF YEAR)
0	0	0	0	0	0	0	0	283500	ACTUAL USAGE (TO DATE)
									PROJECTED VS. ACTUAL USAGE (TO DATE)
.84	.8	.8	.82	.82	.8	.8	.8		PROJECTED PRICE (BEGINNING OF YEAR)
0	0	0	0	0	0	0	0		ACTUAL PRICE
									PROJECTED VS. ACTUAL PRICE
69994	66653	59079	60556	39853	38881	2525	2525	955355	PROJECTED EXPENDITURES
0	0	0	0	0	0	0	0	231891	ACTUAL EXPENDITURES (TO DATE)
0	0	0	0	0	0	0	0		PROJECTED VS. ACTUAL EXPENDITURES
83316	83316	73849	73849	48601	48601	3156	3156	1098485	UPDATED PROJECTION OF USAGE
.84	.8	.8	.82	.82	.8	.8	.8		UPDATED PROJECTION OF PRICE
69994	66653	59079	60556	39853	38881	2525	2525	925147	UPDATED PROJECTION OF EXPENDITURE
									NO. 5 FUEL OIL
215089	215088	166080	166080	54453	54453	0	0	2722630	PROJECTED USAGE (BEGINNING OF YEAR)
0	0	0	0	0	0	0	0	713050	ACTUAL USAGE (TO DATE)
									PROJECTED VS. ACTUAL USAGE (TO DATE)
.8	.76	.74	.72	.72	.72	.72	.72		PROJECTED PRICE (BEGINNING OF YEAR)
0	0	0	0	0	0	0	0		ACTUAL PRICE
									PROJECTED VS. ACTUAL PRICE
172070	163467	122900	119578	39206	39206	0	0	2176103	PROJECTED EXPENDITURES
0	0	0	0	0	0	0	0	540734	ACTUAL EXPENDITURES (TO DATE)
0	0	0	0	0	0	0	0		PROJECTED VS. ACTUAL EXPENDITURES
215089	215088	166080	166080	54453	54453	0	0	2782249	UPDATED PROJECTION OF USAGE
.8	.76	.74	.72	.72	.72	.72	.72		UPDATED PROJECTION OF PRICE
172070	163467	122900	119578	39206	39206	0	0	2160312	UPDATED PROJECTION OF EXPENDITURE

APPENDIX E

Application of the Procurement/Delivery Model to FY 1984

Using the various assumptions and cost components discussed in Chapter 2 and Appendix C, the model was applied to FY 1984 to (1) calculate the actual cost to MCPS of Alternative A (COG purchase, MCPS haul); (2) calculate what the cost of Alternative C (COG purchase, vendor haul) would have been if it had been selected (using actual data); and (3) simulate what the costs of both Alternatives A and C would have been under different "what if" conditions of usage and price.

Since the price per gallon of the fuel oil is available from the COG contract and the Montgomery County Fuel Tax rate is available from the county, it only remained to calculate the MCPS hauling costs in order to load and run the model.

Exhibit E-1 summarizes MCPS fuel oil hauling costs for FY 1983 and FY 1984. In FY 1983, for which actual costs were available, the MCPS costs to haul fuel oil amounted to $92,364, of which $56,862 (62 percent) is labor related and $35,502 (38 percent) is vehicle related. Based on 4,269,454 gallons of

EXHIBIT E-1

Summary of MCPS Fuel Oil Hauling Costs
FY 1983 Actual and FY 1984 Projected*

	Cost	
Item	FY 1983	FY 1984
Direct Salaries	$40,633	$44,696
Overtime Salaries	3,107	3,417
Benefits	13,122	14,434
Vehicle Maintenance and Operation	22,981	23,670
Depreciation	12,521	12,512
Total Cost	$92,364	$98,738

* Since the report was drafted before FY 1984 actual costs were available, the FY 1984 column is based on 5 percent step, 5 percent C.O.L., and 3 percent inflation rate.

fuel oil delivered in FY 1983, the cost amounts to $0.0216 per gallon or a little over 2 cents per gallon. The FY 1984 costs, for which some actual data were not available when the model was run, are similar to those for FY 1983.

In FY 1984 MCPS used Alternative A, purchase of fuel oil under the COG contract and delivery by the MCPS Division of Supply and Property Management. For the calculation of costs for this alternative, the model used actual fuel oil usage data per month for Price Periods 1 through 16 for both No. 2 and No. 5 fuel oil. The model projected usage for the Price Periods 17 through 24 based on the average monthly usage for these months (percentage of total) obtained from actual usage for the past three years. This data is seen in Exhibits E-2 and E-3.

Likewise, the actual period-by-period price to purchase both No. 2 and No. 5 fuel oil under the COG contract was used for the periods available at the time the model was built, that is Price Periods 1 through 18. Fuel prices for the remaining Price Periods 19 through 24 were projected using the trends for FY 1984 and actual prices for the same periods in FY 1983.

The model included only fuel oil that is currently delivered by MCPS and excluded fuel oil that is delivered by the vendor to those elementary schools that have small storage tanks. It was assumed that logistical conditions would preclude MCPS delivery to these schools under any conditions.

The model calculated a per period MCPS hauling cost by multiplying the per gallon costs described previously by the number of gallons delivered during that price period.

The model also calculated the Montgomery County fuel oil tax that would have been paid under the alternative where the vendor rather than MCPS actually made the delivery.

The run of the model which resulted from these various calculations is shown in Exhibit E-4.

EXHIBIT E-2

MCPS Deliveries of No. 2 Fuel Oil by Month

FY 1981 - FY 1983 *

Month	FY 81	FY 82	FY 83	AVG.
July	1.0	0.4	1.5	1.0
August	0.8	0.8	0.5	0.7
September	1.3	1.3	1.5	1.4
October	1.4	1.5	0.5	1.1
November	5.6	4.2	4.0	4.6
December	15.6	18.5	14.5	16.2
January	24.8	22.7	22.1	23.2
February	18.4	20.2	17.5	18.7
March	13.7	12.0	14.0	13.2
April	15.0	10.1	10.0	11.7
May	1.6	7.5	14.0	7.7
June	0.8	0.8	0.0	0.5

* As a percentage of total deliveries

EXHIBIT E-3

MCPS Deliveries of No. 5 Fuel Oil by Month

FY 1981 - 1983*

Month	FY 81	FY 82	FY 83	AVG.
July	0.1	0.2	1.2	0.5
August	0.7	0.9	1.6	1.1
September	1.5	0.9	1.6	1.3
October	1.4	0.7	1.2	1.1
November	6.6	5.0	2.8	4.8
December	14.8	19.3	17.8	17.3
January	28.9	25.5	19.9	24.8
February	19.0	18.7	19.9	19.2
March	14.8	13.5	13.0	13.8
April	11.4	12.2	13.0	12.2
May	0.7	3.1	8.1	4.0
June	0.0	0.0	0.0	0.0

* As a percentage of total deliveries

Exhibit E-4

FUEL OIL ANALYSIS FOR FY 1984, ACTUAL AND WHAT IF CASE 3 (FO/84- 3)

NOTES: 1. ACTUAL FY 84 FUEL OIL USAGE DATA IS USED FOR PRICE PERIODS 1-16
2. ACTUAL FY 84 PRICE DATA IS USED FOR PRICE PERIODS 1-18
3. PROJECTED USAGE DATA IS USED FOR FY 84 PERIODS 17-24, BASED ON ACTUAL USAGE FOR THESE PERIODS IN FY 81-83
4. PROJECTED PRICE DATA ARE USED FOR FY 84 PRICE PERIODS 19-24, BASED ON TRENDS FOR THESE PERIODS FOR FY 83
5. PROJECTED MCPS HAULING COSTS FOR FY 84 OF $98,738/USAGE ARE USED
6. ASSUMES MONTHLY USAGE EVENLY SPLIT BETWEEN THE TWO PRICE PERIODS

ASSUMPTIONS/WHAT IF CONDITIONS:
1. USAGE INCREASED 5% OVER FY 84 FOR DEC-MARCH
2. COST PER GALLON SAME AS FY 84

	JULY		AUGUST		SEPT	
	PRICE PERIOD 1	PRICE PERIOD 2	PRICE PERIOD 3	PRICE PERIOD 4	PRICE PERIOD 5	PRICE PERIOD 6
ACTUAL FY 84 ALTERNATIVE C						
COG PURCHASE AND DELIVERY						
COG COST OF NO. 2 DELIVERED FY 84	.81995	.8202	.8404	.8499	.86065	.86315
COG COST OF NO. 5 DELIVERED FY 84	.73666	.74507	.76745	.77869	.78227	.78302
USAGE OF NO.2 FUEL OIL FY 84	6300	6300	6300	6300	9450	9450
USAGE OF NO. 5 FUEL OIL FY 84	9450	9450	18900	18900	28350	28350
MC CO TAX FY 84	215.23	215.23	346.55	346.55	519.83	519.83
COST OF ALTERNATIVE C ACTUAL FY 84	12342.36	12423.40	20145.88	20418.16	30830.32	30875.21
WHAT IF FY 84 ALTERNATIVE C						
FOR ABOVE CONDITIONS/ASSUMPTIONS						
COG COST OF NO. 2 DELIVERED	.81995	.8202	.8404	.8499	.86065	.86315
COG COST OF NO. 5 DELIVERED	.73666	.74507	.76745	.77869	.78227	.78302
USAGE OF NO. 2 FUEL OIL	105840	6300	6300	6300	9450	9450
USAGE OF NO. 5 FUEL OIL	9450	9450	18900	18900	28350	28350
MC CO TAX	1541.11	215.23	346.55	346.55	519.83	519.83
COST OF ALTERNATIVE C WHAT IF	95286.05	12423.40	20145.88	20418.16	30830.32	30875.21
ACTUAL FY 84 ALTERNATIVE A						
COG PURCHASE AND MCPS DELIVERY						
COG COST NO. 2 UNDER FILL FY 84	.81255	.8128	.833	.8425	.85325	.85575
COG COST NO. 5 UNDER FILL FY 84	.72906	.73747	.75985	.77109	.77467	.77542
MCPS DELIVERY COST FY 84	391.21	391.21	625.93	625.93	938.90	938.90
COST OF ALTERNATIVE A ACTUAL FY 84	12399.89	12480.94	20235.00	20507.28	30964.00	31008.89
WHAT IF FY 84 ALTERNATIVE A						
FOR ABOVE CONDITIONS/ASSUMPTIONS						
COG COST NO. 2 UNDER FILL	.81255	.8128	.833	.8425	.85325	.85575
COG COST NO. 5 UNDER FILL	.72906	.73747	.75985	.77109	.77467	.77542
MCPS DELIVERY COST	2692.80	367.87	588.59	588.59	882.89	882.89
COST OF ALTERNATIVE A WHAT IF	95582.71	12457.60	20197.66	20469.94	30907.99	30952.88

Exhibit E-4 (continued)

	OCT		NOV		DEC		JAN		FEB	
PRICE PERIOD	PRICE PERIOD 7	PRICE PERIOD 8	PRICE PERIOD 9	PRICE PERIOD 10	PRICE PERIOD 11	PRICE PERIOD 12	PRICE PERIOD 13	PRICE PERIOD 14	PRICE PERIOD 15	PRICE PERIOD 16
.8539		.8374	.82615	.82365	.82615	.8154	.85015	.8649	.99715	.9724
.78017		.77114	.75692	.76242	.76942	.76203	.787039	.801047	.85614	.852881
3150		3150	12600	12600	100800	100800	198500	198500	88116	88116
9450		9450	47250	47250	245700	245700	473844	473844	160655	160655
173.28		173.28	824.42	824.42	4756.90	4756.90	9228.56	9228.56	3406.17	3406.17
10235.67		10098.36	46998.38	47226.75	277079.32	274179.99	550917.04	560482.52	228814.21	226109.76
.8539		.8374	.82615	.82365	.82615	.8154	.85015	.8649	.99715	.9724
.78017		.77114	.75692	.76242	.76942	.76203	.787039	.801047	.85614	.852881
3150		3150	12600	12600	105840	105840	208425	208425	92522	92522
9450		9450	47250	47250	257985	257985	497536	497536	168688	168688
173.28		173.28	824.42	824.42	4994.75	4994.75	9689.98	9689.98	3576.48	3576.48
10235.67		10098.36	46998.38	47226.75	290933.28	287888.99	578462.89	588506.65	240254.92	237415.25
.8465		.83	.81875	.81625	.81875	.808	.84275	.8575	.98975	.965
.77257		.76354	.74932	.75482	.76182	.75443	.779439	.793447	.84854	.845281
312.97		312.97	1486.59	1486.59	8606.55	8606.55	16700.03	16700.03	6179.10	6179.10
10280.23		10142.92	47208.21	47436.58	278315.72	275416.40	553318.40	562883.88	229714.11	227009.66
.8465		.83	.81875	.81625	.81875	.808	.84275	.8575	.98975	.965
.77257		.76354	.74932	.75482	.76182	.75443	.779439	.793447	.84854	.845281
294.30		294.30	1397.90	1397.90	8497.77	8497.77	16488.96	16488.96	6101.01	6101.01
10261.56		10124.25	47119.52	47347.90	291692.40	288648.11	579938.25	589982.00	240812.76	237973.09

Exhibit E-4 (continued)

	OCT		NOV		DEC		JAN		FEB	
PRICE PERIOD	PRICE PERIOD 7	PRICE PERIOD 8	PRICE PERIOD 9	PRICE PERIOD 10	PRICE PERIOD 11	PRICE PERIOD 12	PRICE PERIOD 13	PRICE PERIOD 14	PRICE PERIOD 15	PRICE PERIOD 16
.8539	.8374	.82615	.82365	.82615	.8154	.85015	.8649	.99715	.9724	
.78017	.77114	.75692	.76242	.76942	.76203	.787039	.801047	.85614	.852881	
3150	3150	12600	12600	100800	100800	198500	198500	88116	88116	
9450	9450	47250	47250	245700	245700	473844	473844	160655	160655	
173.28	173.28	824.42	824.42	4756.90	4756.90	9228.56	9228.56	3406.17	3406.17	
10235.67	10098.36	46998.38	47226.75	277079.32	274179.99	550917.04	560482.52	228814.21	226109.76	
.8539	.8374	.82615	.82365	.82615	.8154	.85015	.8649	.99715	.9724	
.78017	.77114	.75692	.76242	.76942	.76203	.787039	.801047	.85614	.852881	
3150	3150	12600	12600	105840	105840	208425	208425	92522	92522	
9450	9450	47250	47250	257985	257985	497536	497536	168688	168688	
173.28	173.28	824.42	824.42	4994.75	4994.75	9689.98	9689.98	3576.48	3576.48	
10235.67	10098.36	46998.38	47226.75	290933.28	287888.99	578462.89	588506.65	240254.92	237415.25	
.8465	.83	.81875	.81625	.81875	.808	.84275	.8575	.98975	.965	
.77257	.76354	.74932	.75482	.76182	.75443	.779439	.793447	.84854	.845281	
312.97	312.97	1486.59	1486.59	8606.55	8606.55	16700.03	16700.03	6179.10	6179.10	
10280.23	10142.92	47208.21	47436.58	278315.72	275416.40	553318.40	562883.88	229714.11	227009.66	
.8465	.83	.81875	.81625	.81875	.808	.84275	.8575	.98975	.965	
.77257	.76354	.74932	.75482	.76182	.75443	.779439	.793447	.84854	.845281	
294.30	294.30	1397.90	1397.90	8497.77	8497.77	16488.96	16488.96	6101.01	6101.01	
10261.56	10124.25	47119.52	47347.90	291692.40	288648.11	579938.25	589982.00	240812.76	237973.09	